Request for an Incidental Harassment Authorization under the Marine Mammal Protection Act

by
U.S. Geological Survey

2-D Seismic Reflection Scientific Research Survey Program: Mapping the U.S. Atlantic Seaboard Extended Continental Shelf Region and Investigating Tsunami Hazards, August-September 2014 and April-August, 2015

March 2014

Submitted to:

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ACRONYMS AND ABBREVIATIONS

μ	micro
2-D	two dimensional
BOEM	Bureau of Ocean Energy Management
CeTAP	Cetaceans and Turtle Assessment Program
dB	decibel
ECS	extended continental shelf
EEZ	Exclusive Ecomonic Zone
EIS	*Environmental Impact Statement*
ESA	Endangered Species Act
EZ	exclusion zone
IHA	Incidental Harassment Authorization
in^3	cubic inch(es)
kHz	kiloHertz
kw	kilowatt(s)
L-DEO	Lamont-Doherty Earth Observatory
MBES	multibeam echosounder
NASA	National Aeronautics and Space Administration
NEFSC	Northeast Fisheries Science Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NODE	(U.S. Department of the) Navy Operating Area (OPAREA) Density Estimates
NSF	National Science Foundation
OBIS	Ocean Biogeographic Information System
OEIS	*Overseas Environmental Impact Statement*
OPAREA	Operating Area
Pa	Pascal
PAM	Passive acoustic monitoring
PEIS	*Final Programmatic Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey* (June 2011)
PSAO	Protected Species Acoustic Observer

PSVO	Protected Species Visual Observer
PTS	permanent threshold shift
R/V Langseth	*Research Vessel Marcus G. Langseth*
RMS	root-mean-squared
SAR	Stock Assessment Report
SBP	sub-bottom profiler
SEFSC	Southeast Fisheries Science Center
SEL	sound exposure level
SERDP	Strategic Environmental and Development Program
SPL	sound pressure level
TTS	temporary threshold shift
UME	Unusual Mortality Event
USGS	United States Geological Survey

I. DESCRIPTION OF THE ACTIVITY

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

Overview of the Activity

The United States Geological Survey (USGS), Coastal and Marine Geology Program (Debbie Hutchinson, Principal Investigator), plans to conduct a regional marine two dimensional (2-D) seismic survey in the northwest Atlantic Ocean within the U.S. Exclusive Economic Zone (EEZ) and extending into International Waters as far as 350 nautical miles from the U.S. coast (Study Area) (**Figure 1**). Water depths in the Study Area range from approximately 1,400 meters to 5,400 meters. The proposed USGS survey is planned to be conducted in two phases; one survey during August and September, 2014, and the second survey is expected to take place between April 1 and August 31, 2015 (specific dates to be determined). The activities for both Phase 1 and Phase 2 are included in this application (**Figure 2**).

USGS plans to use conventional marine seismic methodology to: (1) establish the outer limits of the U.S. continental shelf, also referred to as the Extended Continental Shelf (ECS) as defined by Article 76 of the Convention of the Law of the Sea; and (2) study the sudden mass transport of sediments down the continental shelf as submarine landslides that may pose significant tsunamigenic (i.e., earthquake potential along the subduction zone) hazards to the Atlantic and Caribbean coastal communities.

The proposed survey will use the *Research Vessel Marcus G. Langseth* (*R/V Langseth*) as the sole source vessel. To conduct the proposed survey, the *R/V Langseth* will deploy a 36-airgun array as the energy source and one 8-kilometer multichannel hydrophone cable as the receiving system. The hydrophone cable will receive the returning acoustic signals from the towed airgun array and the data will be processed on-board the *R/V Langseth* as the survey occurs.

Each proposed surveys (2014 and 2015) will each consist of a 17- to 18-day leg (exclusive of transit and equipment deployment and recovery) comprising approximately 1,700 nautical trackline miles (approximately 3,150 kilometers) of 2-D seismic reflection coverage. The airgun array will operate continuously during the survey with shutdowns only for repairs and marine mammal and sea turtle mitigation. Data will continue to be acquired between line changes. The successive track segments can be surveyed as almost one continuous line. Turns of no greater than 120 degrees will be required to move from one line segment to the next. The 2014 proposed survey design consists primarily of the track lines that run along the periphery of the overall Study Area, including several internal track lines (**Figure 2**). The proposed 2014 survey will occur in water depths ranging between 1,450 meters and 5,400 meters. The 2015 proposed survey consists of additional dip and tie lines. (Dip lines are lines that are perpendicular to the north-south trend of the continental margin. Strike lines are parallel to the margin. Tie lines are any line that connects other lines.) The 2015 survey design may be modified based on the 2014 results.

Along with the airgun operations, two additional acoustical data acquisition systems will be operated during the survey. A Kongsberg EM122 multibeam echosounder (MBES) and a Knudsen Model 3260 Chirp sub-bottom profiler (SBP) will be operated continuously during the seismic operations in

order to map the ocean floor. MBES and SBP will not operate during transits at the beginning and end of the survey.

The Langseth has been used to conduct research seismic surveys world-wide since 2008. All of the seismic surveys have been operated under incidental harassment authorizations issued by NMFS. Environmental assessments, IHA's and post-cruise reports environmental impact for most of these cruises cruises can be found on the NMFS Protected Resource website. Many of these reports and applications were prepared by LGL Limited, Environmental Research Associates, under contract to Lamont Doherty Earth Observatory or the USGS. Because material from earlier documents is owned by the U.S. Government and in the public domain, some material common to these documents may have been used verbatim herein without attribution. The USGS acknowledges role of LGL in preparing material that has been used.

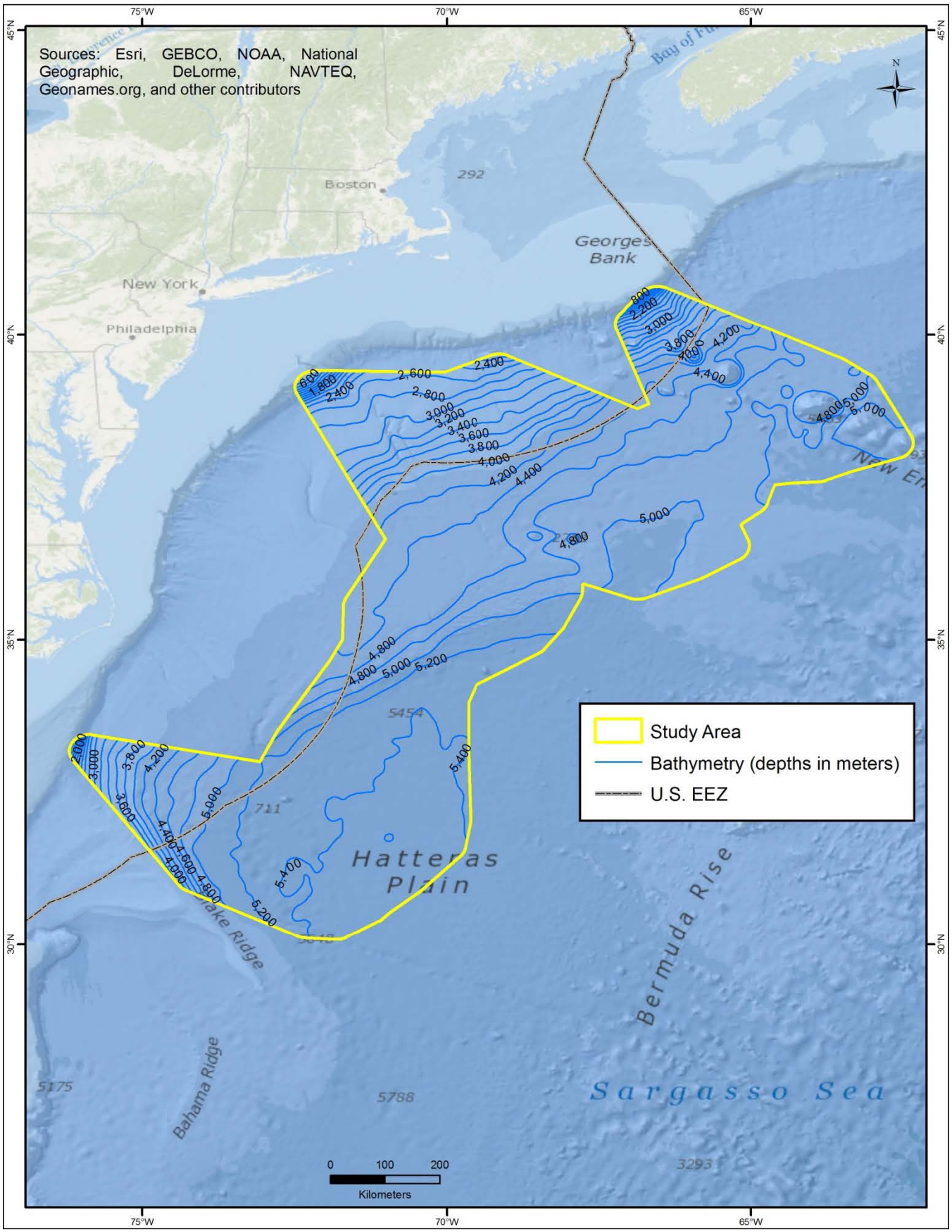


Figure 1 Proposed USGS Study Area

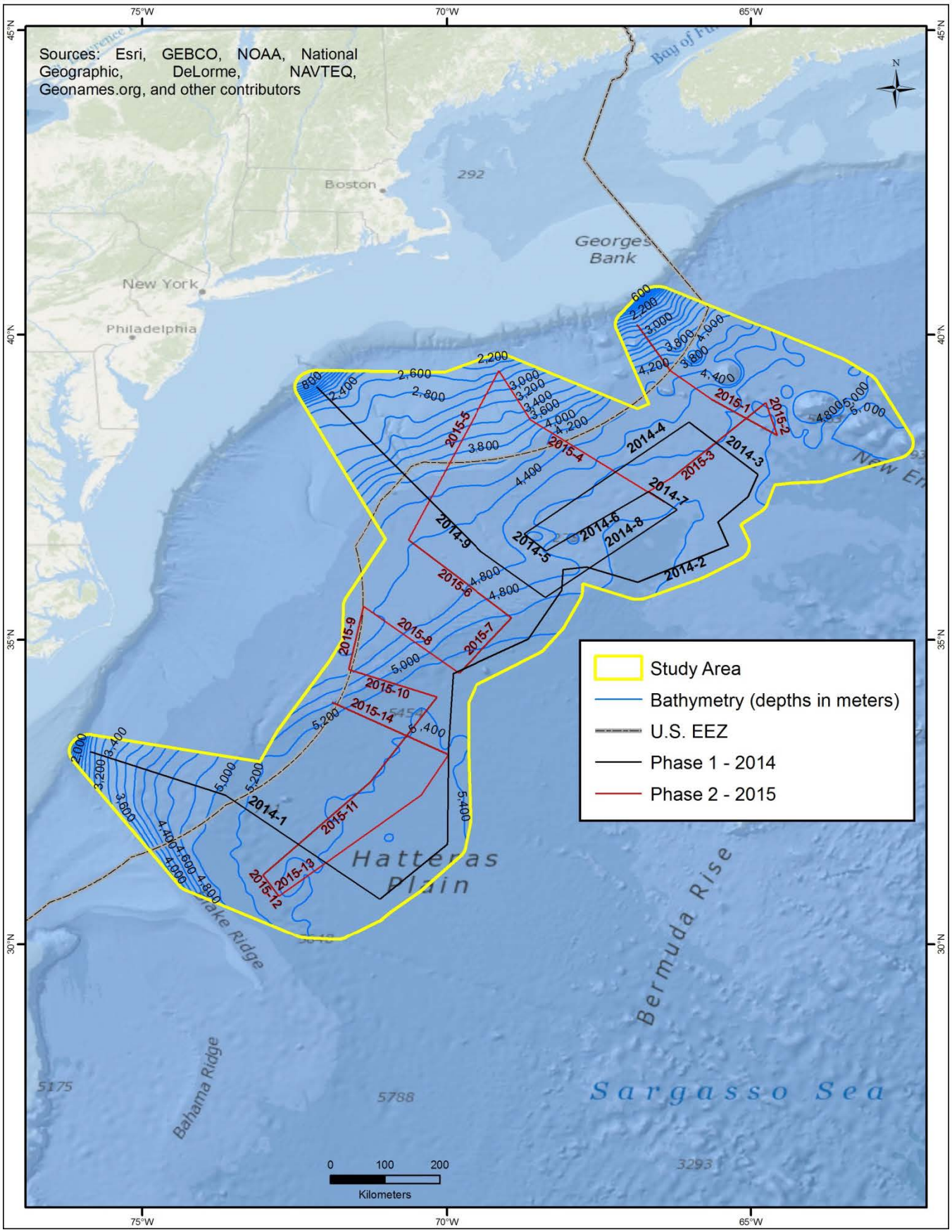


Figure 2 Proposed Seismic Survey Lines, Phases 1 and 2

Vessel Specifications

The *R/V Marcus G. Langseth* will be used as the source vessel; it is owned by the NSF and operated by Lamont-Doherty Earth Observatory (L-DEO) of Columbia University. The *R/V Langseth* was designed as a seismic research vessel with a quiet propulsion system to avoid interference with the seismic signals. The operation speed during seismic acquisition is typically 7.8 to 8.3 kilometers per hour (4.2 to 4.5 knots). When not towing seismic survey gear, the *R/V Langseth* can cruise at 20 to 24 kilometers per hour (11 to 12 knots). The *R/V Langseth* was further described in Section 2.2.2.1 of the *Final Programmatic Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey* (June 2011; referred to herein as the PEIS) and the Record of Decision (June 2012).

Airgun Description

During the proposed 2-D survey, the airgun array to be used will consist of 36 airguns (plus 4 spare airguns), with a total volume of approximately 6,600 cubic inches (in^3). The airgun array and configuration are described and illustrated in the PEIS in Section 2.2.3.1 and on Figure 2.11, respectively. For the 2014 and 2015 proposed survey, the airgun array will be towed at a depth of 9 meters and shot intervals will be 50 meters (approximately 20 to 24 seconds). The firing pressure of the array is 2,000 pounds per square inch.

Predicted Sound Levels

The airgun array that will be used for the USGS East Coast survey is the full 4-string 6,600-in^3 array, which is described and illustrated in the PEIS in Section 2.2.3.1.

Received sound levels have been predicted by L-DEO's model (Diebold et al. 2010, provided as Appendix H of the PEIS) as a function of distance from the airguns, for the 36-airgun array at any tow depth and for a single 1900LL 40-in^3 airgun (i.e., the mitigation gun), which will be used during power-downs. This modeling approach uses ray tracing for the direct wave traveling from the array to the receiver and its associated source ghost (reflection at the air-water interface in the vicinity of the array), in a constant-velocity half-space (infinite homogeneous ocean layer, unbounded by a seafloor). In addition, propagation measurements of pulses from the 36-airgun array at a tow depth of 6 meters have been reported in approximately 1,600 meters water depth (deep water), 50 meters depth (shallow water) and a slope site (intermediate water depth) in the Gulf of Mexico in 2007–2008 (Tolstoy et al. 2009; Diebold et al. 2010), while propagation measurements of pulses from the 18-airgun 2-string array also at a tow depth of 6 meters have been reported for the same shallow and deep sites (Diebold et al. 2010).

For deep water and intermediate water depth cases, these field measurements cannot be used readily to derive mitigation radii because at those sites, the calibration hydrophone was located at a roughly constant depth of 350 to 500 meters, which may not intersect all the sound pressure level (SPL) isopleths at their widest point from the sea surface down to the maximum relevant water depth for marine mammals of approximately 2,000 meters. Figures 2 and 3 in Appendix H of the PEIS show how the values along the maximum SPL line that connects the points where the isopleths attain their maximum width (providing the maximum distance associated with each sound level) may differ from values obtained along a constant depth line. At short ranges, where the direct arrivals dominate and the effects of

seafloor interactions are minimal, the data recorded at the deep and slope sites are suited for comparison with modeled levels at the depth of the calibration hydrophone. At larger ranges, the comparison with the mitigation model—constructed from the maximum SPL, through the entire water column at varying distances from the airgun array—is the most relevant. The results are summarized below.

In deep water and intermediate depth water environments, comparisons at short ranges between sound levels for direct arrivals recorded by the calibration hydrophone and model results for the same array tow depth are consistent (Figures 12 and 14 in Appendix H of the PEIS). Consequently, isopleths falling within this domain can be reliably predicted by the L-DEO model, while they may be imperfectly sampled by measurements recorded at a single depth. At larger distances, the calibration data show that seafloor reflected and sub-seafloor refracted arrivals dominate, while the direct arrivals become weak and/or incoherent (Figures 11, 12 and 16 in Appendix H of the PEIS). Aside from local topography effects, the region around the critical distance (approximately 5 kilometers in Figures 11 and 12, and approximately 4 kilometers in Figure 16, in Appendix H of the PEIS) is where the observed levels rise very close to the mitigation model curve. However, the observed sound levels fall almost entirely below the mitigation model curve (Figures 11, 12 and 16 in Appendix H of the PEIS). Thus, analysis of the Gulf of Mexico calibration measurements demonstrates that although simple, the L-DEO model is a robust tool for estimating mitigation radii.

The proposed survey on the East Coast margin will acquire data with the 36-airgun array at a tow depth of 9 meters. The survey will take place entirely in deep water (greater than 1,000 meters). The deep-water radii obtained from 9-meter tow depth L-DEO model results will be used down to a maximum water depth of 2,000 meters (**Figure 3**).

Measurements have not been reported for the single 40-in^3 airgun. The 40-in^3 airgun would be considered under the low-energy sources category in the PEIS. In Section 2.4.2 of the PEIS, Alternative B (the Preferred Alternative) conservatively applies a 100-meter exclusion zone (EZ) for all low-energy acoustic sources in water depths greater than 100 meters. This approach is adopted here for the single Bolt 1900LL 40-in^3 airgun that will be used during power-downs. In addition, L-DEO model results are used to determine the 160- and the 190-decibel (dB) radii for the 40-in^3 airgun in deep water (**Figure 4**).

Table 1 shows the distances at which the 160-dB, 180-dB, and 190-dB root-mean-squared (RMS) sound levels are expected to be received for the 36-airgun array and the single (mitigation) airgun.

The 180-dB re 1 micro (μ) pascal (Pa) $_{RMS}$ distance is the safety criterion as specified by the National Marine Fisheries Service (NMFS) (2000) for cetaceans. If marine mammals or sea turtles are detected within or about to enter the appropriate exclusion zone, the airguns would be immediately powered down (or shut down if necessary).

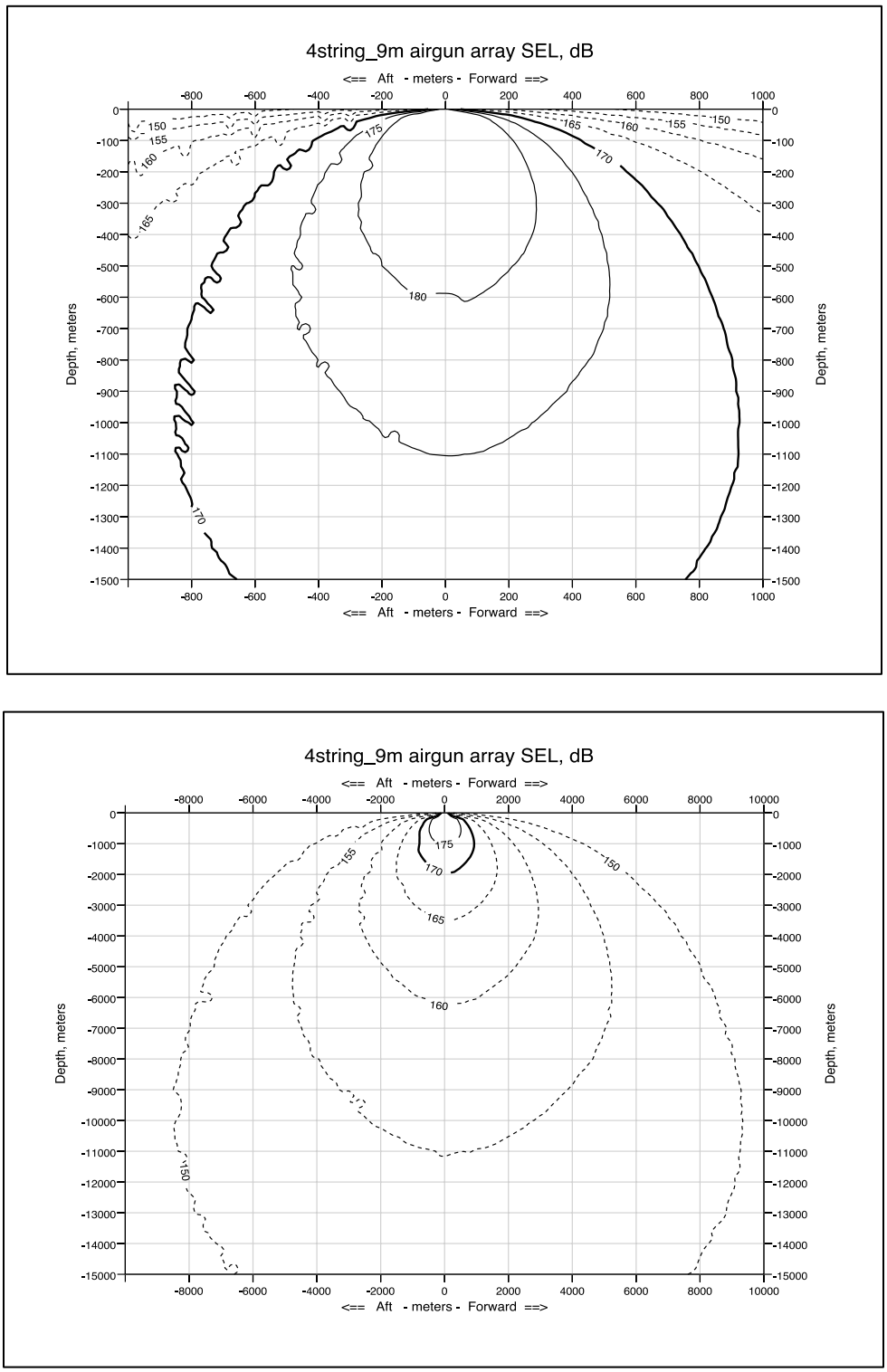


Figure 3 Modeled Deep-Water Received Sound Exposure Levels (SELs) from the 36-Airgun Array Towed at 9 Meters Depth

Modeled deep-water received sound exposure levels (SELs) from the 36-airgun array planned for use during the survey, at a 9-meter tow depth. Received RMS levels (SPLs) are expected to be ~10 dB higher. Plot at the top provides radius to the 170 dB SEL isopleths as a proxy for the 180 dB RMS isopleths and plot at the bottom provides radius to the 150 dB SEL isopleth as a proxy for the 160 dB RMS isopleth.

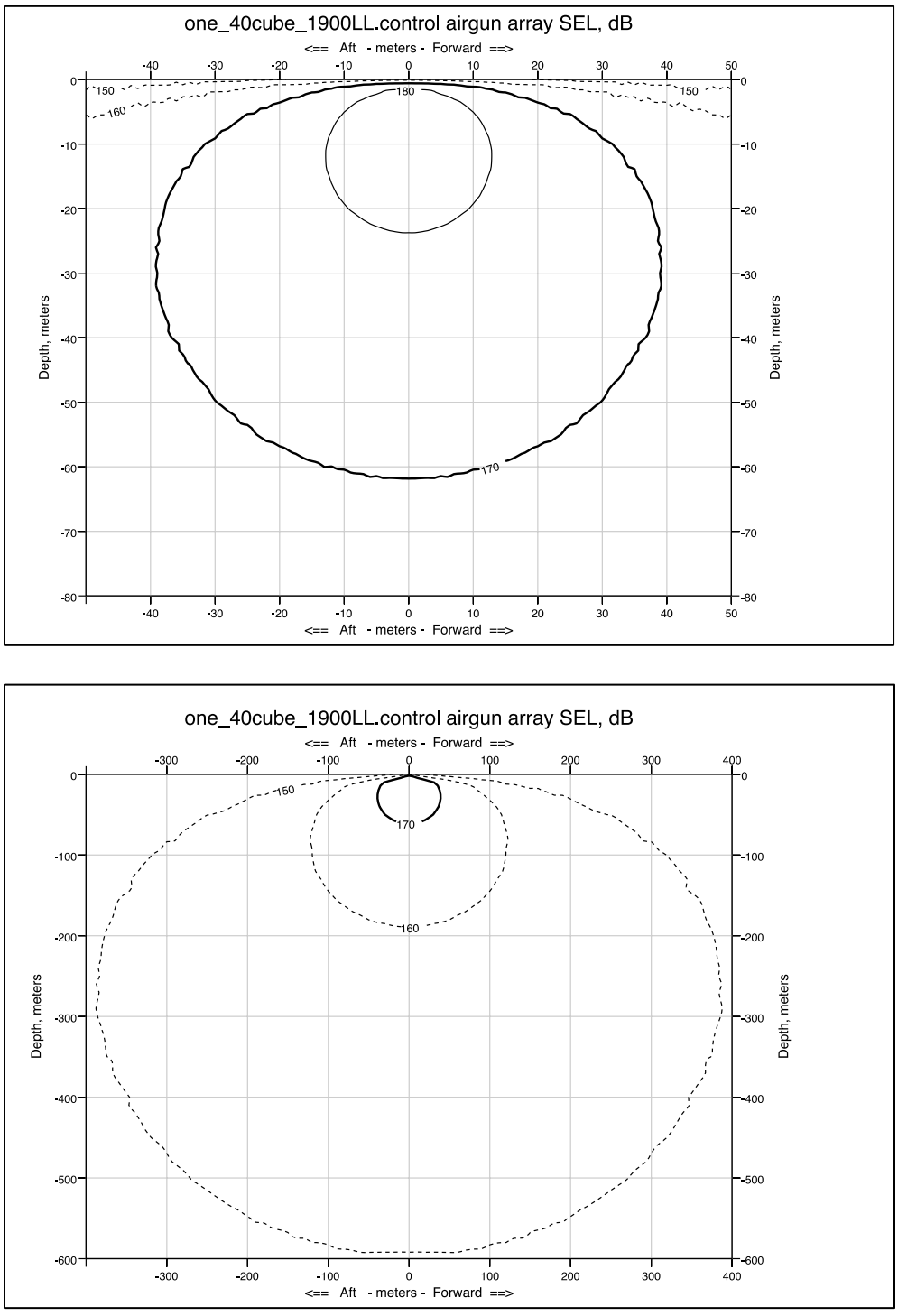


Figure 4 Modeled Deep-Water Received Sound Exposure Levels (SELs) from a Single 40-in^3 Airgun Towed at 9 Meters Depth

Modeled deep-water received SELs from a single 40-in^3 airgun towed at 9 meters depth, which is planned for use as a mitigation gun during the proposed survey. Received RMS levels (SPLs) are expected to be ~10 dB higher. Plot at the top provides radius to the 170 dB SEL isopleths as a proxy for the 180 dB RMS isopleths and plot at the bottom provides radius to the 150 dB SEL isopleth as a proxy for the 160 dB RMS isopleth.

Table 1 Predicted Distances to Sound Levels ≥ 190, 180 and 160 dB re 1 μPa_{RMS}

Predicted distances to which sound levels ≥190, 180 and 160 dB re 1 μPa_{RMS} are expected to be received during the proposed survey on the East Coast margin in 2014 and 2015. For the single mitigation airgun, the EZ is the conservative EZ for all low-energy acoustic sources in water depths >100 meter defined in the PEIS.

Source and Volume	Water Depth (meters)	Predicted RMS Radii (meters)		
		190 dB	180 dB	160 dB
Single Bolt airgun, 40 cubic-inch	>1,000	13	100	388
36-gun array totaling 6,600 cubic inches	>1,000	286	927	5,780

Southall et al. (2007) provided detailed recommendations for new science-based noise exposure criteria. Although the NSF is aware that the National Oceanic and Atmospheric Administration (NOAA) is revising acoustic guidance for marine mammals, at the time of preparation of this Incidental Harassment Authorization (IHA) application, NOAA has not issued an official revised version of that policy. As such, this IHA application has been prepared in accordance with the current NOAA acoustic guidance and the procedures are based on best practices noted by Pierson et al. (1998) and Weir and Dolman (2007).

Description of Operations

During the survey, the source vessel, the R/V *Marcus G. Langseth*, will tow a standard 36-airgun array at a depth of 9 meters. The *R/V Langseth* also will tow one 8-kilometer long hydrophone streamer cable. As the airgun array is towed along the survey lines, the hydrophone streamer cable will receive and record the returning acoustic signals from the towed airgun array and the data will be processed on-board the *R/V Langseth* as the survey occurs.

During the 2014 survey, 1,700 nautical track line miles (approximately 3,150 kilometers) of 2-D survey lines will be shot (**Figure 2**). All water depths will be greater than 1,000 meters. Due to the almost continuous nature of the 2014 and 2015 survey track line segments (**Figure 2**), full turns will not be required. Only 90 to 120-degree turns will be conducted with 2-D seismic data being collected continuously during the turns. In addition to the operations of the airgun array during the 2-D survey, a MBES and a SBP also will run continuously. The plan for the 2015 (**Figure 2**) survey is similar in all respects to the 2014.

Multibeam Echosounder and Sub-bottom Profiler

Along with the airgun operations, two additional acoustical data acquisition systems will be operated during the survey. The ocean floor will be mapped with the Kongsberg EM 122 MBES and a Knudsen Chirp 3260 SBP. These sound sources will be operated from the *R/V Langseth* continuously throughout the survey.

The Kongsberg EM 122 MBES operates at 10.5 to 13 (usually 12) kiloHertz (kHz) and is hull-mounted on the *R/V Langseth*. The maximum source level is 242 dB re 1 μPa_{RMS}. The Knudsen Chirp 3260 SBP normally is operated to provide information about the sedimentary features and the bottom topography that is being mapped simultaneously by the MBES. The SBP is capable of reaching water depths of 10,000 meters and penetrating tens of meters into the sediments. The nominal power output is 10 kilowatts (kw), but the actual maximum radiated power is 3 kW or 222 dB re 1 μPa m.

II. DATES, DURATION, AND REGION OF ACTIVITY

The date(s) and duration of such activity and the specific geographical region where it will occur.

The proposed survey area would be bounded by the following geographic coordinates:

40.5694° N / -66.5324° W
38.5808° N / -61.7105° W
29.2456° N / -72.6766° W
33.1752° N / -75.8697° W
39.1583° N / -72.8697° W

The proposed 2014 survey activities will generally occur within the outer portions of the Study Area. The proposed 2015 survey will in-fill more of the Study Area. The track lines proposed for both years occur primarily within International Waters (approximately 80% in 2014 and 90% in 2015, **Figure 2**). Water depths range between approximately 1,450 meters and 5,400 meters; no survey lines will extend to water depths less than 1,000 m. The exact dates of the survey are dependent on logistics and weather conditions; however, the *R/V Langseth* is expected to depart Newark, New Jersey, on August 16, 2014, and transit to the survey area, returning to Norfolk, Virginia, on September 6, 2014. The seismic operations will take approximately 16 days to complete. Approximately one day transit will be required at the beginning and end of the program. The survey schedule is inclusive of weather and other contingency (e.g. equipment failure) time.

The proposed 2015 survey will be virtually identical to the program planned for 2014. Geographic area, duration, and trackline coverage are similar. Exact dates for the survey in 2015 are uncertain, but are scheduled to occur within the April to August time frame.

III. SPECIES AND NUMBERS OF MARINE MAMMALS IN AREA

The species and numbers of marine mammals likely to be found within the activity area.

Thirty-eight marine mammal species could occur within the Study Area. To avoid redundancy and consolidate species-specific information, required information regarding species and numbers of species as is required under Section III, is included below in Section IV

IV. STATUS, DISTRIBUTION, AND SEASONAL DISTRIBUTION OF AFFECTED SPECIES OR STOCKS OF MARINE MAMMALS

A description of the status, distribution, and seasonal distribution (when applicable) of the affected species or stocks of marine mammals likely to be affected by such activities.

Sections III and IV are integrated here to minimize repetition.

Forty-five species of marine mammals, including 30 odontocetes, 7 mysticetes, 7 pinnipeds, and 1 sirenian are known to occur in western North Atlantic Ocean (Waring et al. 2013; Read et al. 2009). Of those 45 species of marine mammals, 34 cetaceans and 4 pinnipeds could be found within the Study Area during the summer months (see **Table 2**). Six of the cetaceans are listed as ***Endangered*** under the Endangered Species Act (ESA) (sei, blue, fin, North Atlantic right, humpback, and sperm whales). Fourteen of the 34 cetacean species, although present in the wider western North Atlantic Ocean, are considered rare in the survey area; however, due to the chance that an individual could be found within the Study Area during the proposed survey, they are discussed in this document. The four pinniped species (harbor seal, harp seal, gray seal, and hooded seal) also are considered rare within the Study Area. All pinnipeds known to occur within the North Atlantic Ocean are considered coastal species and any sightings would be considered extralimital; however, due to the limited chance that they could occur within the Study Area during the summer months, similar to the rare cetacean species, they are discussed in this document.

General information on the taxonomy, ecology, distribution, seasonality and movements, and acoustic capabilities of mysticetes, odontocetes, and pinnipeds are provided in Sections 3.6.1, 3.7.1, and 3.8.1 respectively, of the PEIS. The general distribution of mysticetes, odontocetes, and pinnipeds in the North Atlantic is discussed in Sections 3.6.3.4, 3.7.3.4, and 3.8.3.4, respectively, of the PEIS. In addition, Section 3.1 of the *Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas Draft Programmatic Environmental Impact Statement* (Bureau of Ocean Energy Management 2012) reviews similar information for all marine mammals that may occur within the Study Area.

The rest of this section deals specifically with their distribution within the Study Area and near the proposed 2014 survey area. Various surveys have been conducted throughout the western North Atlantic, including within sections of the Study Area. The main source of information used here is the Ocean Biogeographic Information System (OBIS) database hosted by Rutgers and Duke Universities (Read et al. 2009). This database includes survey data collected during the Cetaceans and Turtle Assessment Program (CeTAP) conducted between 1978 and 1982 and consisted of both aerial and vessel-based surveys between Cape Hatteras, North Carolina, and the Gulf of Maine. The database also includes survey data collected during the NOAA Northeast Fisheries Science Center (NEFSC) and the NOAA Southeast Fisheries Science Center (SEFSC) stock assessment surveys conducted in 2004 (which surveys between Nova Scotia, Canada, and Florida).

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA
ORDER CETACEA								
***Suborder Mysticeti* (Baleen Whales)**								
Fin Whale *(Balaenoptera physalus)*	Regular	Coastal, banks	Canada to North Carolina	Year round	26,500[3] / 3,522	Unable to determine	EN	Depleted
Humpback Whale *(Megaptera novaeangliae)*	Regular	Coastal, banks	Canada to Caribbean	High-latitude summer feeding; low-latitude winter breeding/calving in coastal waters; some remain in high latitudes year round.	11,600[4] / 823[5]	Increasing	EN	Depleted
Minke Whale *(Balaenoptera acutorostrata)*	Regular	Coastal, banks, shelf	Arctic to Caribbean	Spring and Summer – widespread and common occurrence throughout range. Most abundant in New England waters at this time. Fall and Winter – lesser occurrence to largely absent from New England Waters Winter - potential distribution in the Caribbean and south and east of Bermuda	138,000[6] / 20,741	Unable to determine	NL	--
North Atlantic Right Whale (*Eubalaena glacialis)*	Regular	Coastal and shelf waters	Canada to Florida	Spring and Summer – Canada and New England Fall and Winter – migrating along U.S. east cast states and in Southeastern U.S. waters	455 / 455[7]	Increasing	EN	Depleted
Blue Whale (*Balaenoptera musculus*)	Rare	Coastal, shelf, and pelagic	Arctic to Florida	Year round	855[8] / 440[7]	Unable to determine[6]	EN	Depleted
Bryde's Whale (*Balaenoptera edeni*)	Rare	Coastal, offshore	N/A	Unknown	N/A	N/A	NL	--

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA
Sei Whale *(Balaenoptera borealis)*	Rare	Mostly pelagic, some offshore	Canada to Massachusetts	Year round	10,300[9] / 357[10]	Unable to determine	EN	Depleted
Suborder Odontoceti (Toothed Whales, Dolphins, and Porpoises)								
Atlantic White-sided Dolphin (*Lagenorhynchus acutus*)	Regular	Shelf and slope	Central West Greenland to North Carolina	January – May in Georges Bank to Jeffrey's Ledge June – September primarily in Bay of Fundy to George's Bank October - December in Gulf of Maine to George's Bank Year round from Massachusetts to North Carolina	10s–100s of 1000s[11] / 48,819[7]	Unable to determine	NL	--
Atlantic Spotted Dolphin *(Stenella frontalis)*	Regular	Shelf, offshore	Massachusetts to Caribbean	Year round	N/A / 44,715	Unable to determine	NL	--
Bottlenose Dolphin (*Tursiops truncatus*)	Regular	Coastal, shelf, pelagic	Canada to Florida	Year round	N/A / 77,532[12]	Unable to determine	NL	--
Long-Finned Pilot Whale *(Globicephala melas)*	Regular	Mostly pelagic	Canada to North Carolina	Year round	780,000[13] / 26,535	Unable to determine	NL	--
Short-Finned Pilot Whale *Globicephala macrorhynchus)*	Regular	Mostly pelagic, high relief	North Carolina to Florida	Year round	780,000[13] / 21,515	Unable to determine	NL	--
Pantropical Spotted Dolphin (*Stenella attenuata*)	Regular	Coastal, shelf and slope	Massachusetts to Florida	Year round	N/A / 3,333	Unable to determine	NL	--

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA
Risso's Dolphin *(Grampus griseus)*	Regular	Shelf, slope, seamounts	Canada to Florida	Spring, summer and Fall in George's Bank to North Carolina Winter in the mid-Atlantic Bight out to oceanic waters	N/A / 18,250	Unable to determine	NL	--
Shorted-beaked Common Dolphin *(Delphinus delphis)*	Regular	Shelf, pelagic, high relief	Canada to Georgia	Mid-January – May in George's Bank to North Carolina Mid-summer and Autumn in George's Bank and Scotian shelf	N/A / 173,486	Unable to determine	NL	--
Striped Dolphin *(Stenella coeruleoalba)*	Regular	Offshore convergence zones and upwellings	Canada to Caribbean	Year round	N/A / 54,807	Unable to determine	NL	--
Sperm Whale *(Physeter macrocephalus)*	Regular	Pelagic, slope, canyons	Canada to Caribbean	Winter – concentrated east and northeast of North Carolina Spring – widespread in central portion of the mid-Atlantic Bight and southern George's Bank Summer – widespread in central portion of the mid-Atlantic Bight and east and north of George's Bank Fall – south of New England and throughout the mid-Atlantic Bight	13,190[14] / 2,288	Unable to determine	EN	Depleted
Killer whale *(Orcinus orca)*	Rare	Coastal, pelagic	Arctic to Caribbean	Unknown	N/A / N/A	Unable to determine	NL	--
Clymene Dolphin *(Stenella clymene)*	Rare	Coastal, shelf and slope	North Carolina to Florida	Unknown	N/A / N/A	Unable to determine	NL	--
Spinner Dolphin (*Stenella longirostris*)	Rare	Mainly nearshore	Maine to Caribbean	Year round	N/A / N/A	Unable to determine	NL	--

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA
Rough-Toothed Dolphin *(Steno bredanensis)*	Rare	Mostly pelagic	Virginia to Florida	Unknown	N/A / 271	Unable to determine	NL	--
Fraser's Dolphin *(Lagenodelphis hosei)*	Rare	Shelf and slope	North Carolina to Florida	Unknown	N/A / N/A	Unable to determine	NL	--
Harbor Porpoise *(Phocoena phocoena)*	Rare	Shelf, coastal, pelagic	Canada to North Carolina	October – December and April – June in Maine through New Jersey January – March in Canada to North Carolina July – September in northern Gulf of Maine and Southern Bay of Fundy	~500,000[15] / 79,833[9]	Unable to determine	NL	--
False Killer Whale *(Pseudorca crassidens)*	Rare	Pelagic	N/A	Unknown	N/A / N/A	N/A	NL	--
Pygmy Killer Whale *(Feresa attenuata)*	Rare	Pelagic	N/A	Unknown	N/A / N/A	Unable to determine	NL	--
Dwarf Sperm Whale *(Kogia sima)*	Rare	Deep waters off shelf	Massachusetts to Florida	Unknown	N/A / 3,785[16]	Unable to determine	NL	--
Pygmy Sperm Whale *(Kogia breviceps)*	Rare	Deep waters off shelf	Massachusetts to Florida	Unknown	N/A / 3,785[16]	Unable to determine	NL	--
Melon-Headed Whale *(Peponocephala electra)*	Rare	Deep waters off shelf	North Carolina to Florida	Year round	N/A / N/A	Unable to determine	NL	--
Sowerby's Beaked Whale *Mesoplodon bidens)*	Rare	Pelagic, deep slope, canyons	Canada to Florida	Year round	N/A / 7,092[17]	Unable to determine	NL	--
Blainville's Beaked Whale *(Mesoplodon densirostris)*			Canada to Florida	Year round	N/A / 7,092[17]			--
Gervais' Beaked Whale *(Mesoplodon europaeus)*			Canada to Florida	Year round	N/A / 7,092[17]			--

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA
True's Beaked Whale *(Mesoplodon mirus)*			Canada to Bahamas	Year round	N/A / 7,092[17]			--
Cuvier's Beaked Whale *(Ziphius cavirostris)*			Canada to Florida	Year round	N/A / 6,532			--
Northern Bottlenose Whale *(Hyperoodon ampullatus)*	Rare	Pelagic	Arctic to New Jersey	Unknown	N/A / N/A	Unable to determine	NL	--
ORDER CARNIVORA								
Clade Pinnipedia								
Harbor seal (Phoca vitulina)	Rare	Coastal	Canada to North Carolina	Year round in Canada to Massachusetts September – May in Rhode Island to New Jersey (possibly south to North Carolina)	N/A / 70,142	Unable to determine	NL	--
Gray seal *(Halichoerus grypus)*	Rare	Coastal, pelagic	Canada to North Carolina	Year round in Canada to Massachusetts September – May in Rhode Island to New Jersey (possibly south to North Carolina)	N/A / 348,900	Increasing	NL	--
Harp seal *(Phoca groenlandica)*	Rare	Ice whelpers, pelagic	Canada to New Jersey	Winter – Summer in Arctic Fall as far south as New Jersey	8.6–9.6 million[18] / N/A	Unknown	NL	--
Hooded Seal *(Cystophora cristata)*	Rare	Ice whelpers, pelagic	Canada to Caribbean	January – May in New England Summer and Autumn in Caribbean	600,000[19] / N/A	Unable to determine	NL	--

Table 2 The Habitat, Range, Seasonality, Regional Abundance, and Conservation Status of Marine Mammals that Could Occur In or Near the Study Area

Species	Occurrence Near Study Area	Habitat	Range along U.S. East Coast	Seasonality	Regional/SAR abundance estimates[1]	Population Status[1]	ESA[2]	MMPA

Key:
N/A = Not available or not assessed
Sources:
[1] SAR (stock assessment report) abundance estimates are from the Draft Marine Mammal Stock Assessment Reports 2013 for the Western North Atlantic Stock unless otherwise noted.
[2] U.S. Endangered Species Act: EN = Endangered; NL = Not listed (ECOS 2013)
[3] Best estimate for the North Atlantic in 2007 (International Whaling Commission [IWC] 2014)
[4] Best estimate for the western North Atlantic in 1992–1993 (IWC 2014)
[5] Minimum estimate for Gulf of Maine Stock (Waring et al. 2013)
[6] Best estimate for the North Atlantic in 2002–2007 (IWC 2014)
[7] Estimate for the Western North Atlantic Stock (Waring et al. 2013)
[8] Estimate for the central and northeast Atlantic in 2001 (Pike et al. 2009)
[9] Estimate for the Northeast Atlantic in 1989 (Cattanach et al. 1993)
[10] Nova Scotia Stock (Waring et al. 2013)
[11] Tens to low hundreds of thousands in the North Atlantic (Reeves et al. 1999)
[12] Western North Atlantic Offshore Stock (Waring et al. 2013)
[13] Estimate for both long- and short-finned pilot whales in the central and eastern North Atlantic in 1989 (IWC 2014)
[14] Estimate for the North Atlantic (Whitehead 2002)
[15] Estimate for the North Atlantic (Jefferson et al. 2008)
[16] This estimate includes both the dwarf and pygmy sperm whales
[17] Estimate includes all *Mesoplodon* in the Atlantic
[18] Northwest Atlantic (Department of Fisheries and Oceans 2012)
[19] Northwest Atlantic (Andersen et al. 2009)

Mysticetes

Fin whale (*Balaenoptera physalus*)

Fin whales are one of the more common mysticete species found within the Study Area and in the waters surrounding it. According to Palka (2006), they are the most commonly sighted ESA-listed large whale in the western North Atlantic. Hundreds of OBIS sightings of this species near the Study Area boundaries are recorded and 14 sightings within it are recorded. The three most recent sightings were recorded in 2003 and 2004 and were observed during the NEFSC Right Whale Survey. All other sightings are from the 1970s and 1980s.

The NMFS (2010) reports summer feeding grounds mostly between 41°20' and 51°00'N latitude (shore to 1,829 meters). The Study Area and proposed project survey dates coincide with this cycle of the fin whale. Fin whale mating and births occur in the winter (November to March), with reproductive activity peaking in December and January. Hain et al. (1992) suggested that calving takes place during October to January in latitudes of the U.S. Mid-Atlantic region. The proposed 2014 survey period of August–September will not interfere with the reproduction cycle.

Humpback whale (*Megaptera novaeangliae*)

Sightings data show that humpback whales traverse coastal waters from the northeastern to the southeastern U.S. They can also be found farther offshore, including the Study Area (Waring et al. 2011). Reports of humpback whale sightings off Delaware Bay and Chesapeake Bay during the winter suggest that the Mid-Atlantic region, including the western portion of the Study Area, may serve as wintering grounds for this species (Swingle et al. 1993; Barco et al. 2002). OBIS logged four sightings of humpback whales within the Study Area. The most recent sighting is from 2006 and was recorded by the NEFSC Right Whale Survey.

Minke whale (*Balaenoptera acutorostrata*)

The minke whale is among the most widely distributed and most abundant of the baleen whales (Carwardine 1998). The OBIS database reports several sightings of the minke whale along the western edge of the Study Area. The sightings increase toward the northwest, in an area identified as the year-round feeding and mating grounds for the North Atlantic right whale located in the waters off New England. In 1980, OBIS reported three sightings of the minke whale within the Study Area.

North Atlantic right whale (*Eubalaena glacialis*)

Research results suggest the existence of six major congregation areas for the North Atlantic right whale: the coastal waters of the southeastern U.S., the Great South Channel, Georges Bank/Gulf of Maine, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Scotian Shelf (Waring et al. 2011). Movements of individuals within and between these congregation areas are extensive, and data show distant excursions, including into deep water off the continental shelf (Mate, Nieukirk, and Kraus 1997; Baumgartner and Mate 2005). Congregations in U.S. eastern seaboard waters are recorded west of the Study Area; however, movements of the North Atlantic right whale could result in their presence within the Study Area. In addition, year-round feeding and mating grounds exist for the North Atlantic right whale located in the waters off New England. The area overlaps the north section of the Study Area. While the OBIS database makes reference to hundreds of sightings in the vicinity of the Study Area, mainly along the continental shelf, along the western boundary edge of the Study Area, and in the year-round feeding and mating grounds, the OBIS database does not report any sightings within the borders of

the Study Area. Overall, the range and seasonal distribution of North Atlantic right whales (particularly males) is not fully understood at this time.

Blue whale (*Balaenoptera musculus*)

Blue whales are only considered "occasional visitors" within U.S. EEZ waters (Waring et al. 2010). However, this species has been acoustically recorded in the deep offshore waters east of the U.S. EEZ (Clark 1995). The OBIS database reports only one blue whale observation within the Study Area boundary, which was recorded in 1969. Blue whales are considered rare within the Study Area due to the lack of observations within the area, their overall sparse existence within the region, and their preference for the colder waters of Canada (Waring et al. 2013).

Bryde's whale (*Balaenoptera edeni/brydei*)

There is no known U.S. management population of Bryde's whale in the U.S. western North Atlantic waters. The seasonal distribution of this whale is not well known (Reilly et al. 2008). The species generally prefers sub-tropical to tropical and warm temperate waters. The northern extent of its range is ~40°N (NOAA Fisheries Service, Office of Protected Resources [NOAA Fisheries OPR] 2012a). There are no OBIS sightings reported within the Study Area or its surrounding waters. Bryde's whales are considered rare within the waters of the Study Area.

Sei whale (*Balaenoptera borealis*)

Sei whales are typically associated with steep bathymetric relief, such as the continental shelf break, canyons, or basins situated between banks and ledges where prey is concentrated (Kenney and Winn 1987; Schiling et al. 1992; Best and Lockyer 2002). The range of this highly migratory species includes the continental shelf waters of the northeastern U.S. and extends to south of Newfoundland (Jefferson et al. 2008). Sei whales are not common in U.S. Atlantic waters (NMFS 2012); however, OBIS reports six sightings of the sei whale within the Study Area. The most recent sightings occurred in June 2001 and October 2006, both of which were recorded during the NEFSC Right Whale Survey.

Odontocetes

Atlantic White-sided Dolphin (*Lagenorhynchus acutus)*

The Atlantic white-sided dolphin has thousands of recorded sightings in the OBIS database. The sightings occur in coastal, shelf and slope waters, with the majority occurring on the shelf north of the Study Area. Within the Study Area boundaries, ten sightings of this species are recorded in the OBIS database. Nine of those sightings were from the late 1970s and early 1980s, and one sighting was reported in 2002 during the NEFSC Right Whale Survey.

Atlantic Spotted Dolphin (*Stenella frontalis*)

Within the Study Area, OBIS records indicate that eight Atlantic spotted dolphins have been sighted. The sightings were divided between mid- and base-slope waters. Four were observed in 1998 during the NEFSC survey. The other four were observed in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey.

Bottlenose Dolphin (*Tursiops truncatus*)

Within the western North Atlantic stock of bottlenose dolphin, at least six genetically distinct stocks are distributed from southern Long Island, New York, to central Florida (NOAA Fisheries OPR 2013a). These are further divided into two morphotypes: coastal and offshore (Waring et al. 2006). Those

bottlenose dolphins expected to occur within the Study Area would primarily be from the offshore morphotype. The offshore morphotype is primarily found along the outer continental shelf and continental slope in the western North Atlantic (Waring et al. 2006). OBIS sightings are in the thousands for the bottlenose dolphin in coastal and shelf, slope and abyssal waters. Approximately 100 sightings of this species (likely consisting of the offshore morphotype) in the Study Area have been recorded.

As a note, the bottlenose dolphin population most recently affected by the 2013 Unusual Mortality Event (UME) along the U.S. Mid-Atlantic states was likely primarily that of the coastal morphotype. Due to the preference of the offshore morphotype for deeper continental shelf and slope waters, it is not expected that this population was affected by the UME.

Long-Finned Pilot Whale (*Globicephala melas*)

The long-finned pilot whale is considered uncommon in the mid-Atlantic waters, including the Study Area. While the species prefers deep pelagic waters in temperate and sub-polar climates (NOAA Fisheries OPR 2012b), there are only five OBIS sightings of this species within the Study Area boundary. Three of those five sightings occurred in the 1980s. The OBIS database has hundreds of sightings of this species along the shelf and coastal waters of the U.S. and Canada.

Short-Finned Pilot Whale (*Globicephala macrorhynchus*)

Similar to the long-finned pilot whale, the short-finned pilot whale is considered uncommon in mid-Atlantic waters, including the Study Area. This species also prefers deeper waters; however, it differs from the long-finned pilot whale in that it prefers warmer temperate and tropical waters (NOAA Fisheries OPR 2012c). While no OBIS sightings of this species within the Study Area are recorded, OBIS has records of 18 sightings of this species, all of which occurred since 2004. The sightings primarily occurred along the continental shelf break.

Pantropical Spotted Dolphin (*Stenella attenuata*)

This species is known to occur over deeper waters (Waring et al. 2009). There are six OBIS sightings of the pantropical spotted dolphin within the Study Area. Three occurred in shelf and slope waters, one in slopes waters, one at the base of the slope, and one in abyssal depths of 5000 meters. The latter was observed in 2005 during the Sargasso 2005 cetacean sightings survey.

Risso's Dolphin (*Grampus griseus*)

The Risso's dolphin is considered common within the Study Area. The OBIS database has over 100 sightings of this species within the boundaries, and thousands along adjacent coastal, shelf and slope waters. Many of the sightings occur in the shelf and slope waters, nine sightings occurred in the deeper waters, in isobaths of 4,400 meters.

Shorted-beaked Common Dolphin (*Delphinus delphis*)

The short-beaked common dolphin is considered common within the Study Area and surrounding waters. Within the Study Area, the OBIS database reports 83 sightings. Four studies have reported sightings since the year 2000. The NEFSC Right Whale Survey recorded 14 sightings in 2001 and four sightings in 2002. Also in 2001, the Canada Maritime Regional Cetacean Sightings identified one short-beaked common dolphin. Lastly, in 2004 the NEFSC Mid-Atlantic Marine Mammal Abundance Survey reported observing eight of these species.

Striped Dolphin (*Stenella coeruleoalba*)

The striped dolphin prefers oceanic and deep warm temperate and tropical waters (NOAA Fisheries OPR 2012d). OBIS records indicate approximately 75 sightings of the striped dolphin within the Study Area, nearly all occurring along the shelf and slope waters in the north and west extent.

Sperm Whale (*Physeter macrocephalus*)

The sperm whale is the most commonly occurring odontocete species within the Study Area and in the adjacent waters. The sperm whale spends summer months in the Mid-Atlantic Bight off the Eastern U.S. coast from Virginia to Massachusetts (Reeves et al. 2002; Palka 2006). Hundreds of OBIS sightings of the sperm whale place them primarily in shelf and slope waters of the northeast U.S. and Nova Scotia. Sperm whales can be found in groups that consist of 20 to 40 animals, including adult females, their calves, and juveniles (Waring et al. 2006). The OBIS also recorded several sightings at abyssal depths of 5,000 meters. Within the Study Area, greater than 300 OBIS sightings of the sperm whale have been recorded, with the majority occurring in the slope waters in the northern and western extent. Sperm whales tend to be found in association with frontal systems, canyon, slope, and seamount features within the region. The survey plan minimizes encroachment of such areas.

Killer whale (*Orcinus orca*)

The killer whale is a very rare species within the western North Atlantic Ocean. There are four recorded sightings of this species within the Study Area. All four sightings occurred during the CeTAP survey. One sighting occurred in 1978, one in 1980, and the remaining two occurred in 1981. The species is considered rare within the Study Area.

Clymene Dolphin (*Stenella clymene*)

The Clymene dolphin is a rare species within the western North Atlantic Ocean. The species prefers deep, warm temperate, tropical and sub-tropical waters within the Atlantic Ocean (NOAA Fisheries OPR 2012e). There are only seven sightings in shelf and slope waters in southern U.S. waters. There are no OBIS sightings for the Clymene dolphin within the Study Area. This species is considered rare within the Study Area.

Spinner Dolphin (*Stenella longirostris*)

The spinner dolphin is a rare species within the western North Atlantic Ocean. The species prefers deep ocean waters within the Atlantic Ocean (NOAA Fisheries OPR 2012f). The OBIS database only has one sighting record of the spinner dolphin within the Study Area. The sighting occurred in 1997, during a CeTAP vessel survey. Other sightings in adjacent waters occurred in the slopes west of the Study Area. The species is considered rare within the Study Area.

Rough-Toothed Dolphin (*Steno bredanensis*)

The rough-toothed dolphin prefers deep ocean warm temperate and tropical waters within the western North Atlantic Ocean. Observations of this species offshore the East Coast of the U.S. are rare (NOAA Fisheries OPR 2012g). Within the Study Area, there are two OBIS sightings of the rough-toothed dolphin. One observation occurred near the shelf edge in slope waters during the 1998 NEFSC Survey. The other observation occurred near the base of the slope in 1979 during the CeTAP vessel survey. The species is considered rare within the Study Area.

Fraser's Dolphin (*Lagenodelphis hosei*)

The Fraser's dolphin prefers deep ocean waters, primarily deeper than 1,000 meters (NOAA Fisheries OPR 2012h). The overall number of sightings of this species in the western North Atlantic Ocean is low. There are no OBIS sightings of the Fraser's dolphin within the Study Area and only one OBIS sighting in the waters adjacent to its boundaries. This dolphin species was observed near the western boundary of the Study Area and is considered rare within the Study Area.

Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise is primarily a coastal species, preferring waters less than 200 meters deep (NOAA Fisheries OPR 2013b). The OBIS database has records for thousands of sightings of the harbor porpoise in the coastal and shelf waters around the Gulf of Maine. Within the Study Area, only three sightings have been reported. Two observations occurred in the slope waters near the northern extent of the Study Area, and one at abyssal depth of 5,000 meters. The third observation was recorded in 1978 during the Programme Integre de recherches sur les oiseaux pelagiques Northwest Atlantic survey. The species is considered rare within the Study Area.

False Killer Whale (*Pseudorca crassidens*)

The false killer whale does not have a U.S.-managed population in the western North Atlantic Ocean, yet the species can be found sparingly offshore of the Mid-Atlantic states, primarily in waters deeper than 1,000 meters (NOAA Fisheries OPR 2013c). There are only 11 OBIS sightings of this species off the U.S. coast with two occurring within the Study Area; one was recorded in 1971, with the other two occurring in 1997. The false killer whale is considered rare within the Study Area and adjacent waters.

Pygmy Killer Whale (*Feresa attenuata*)

The pygmy killer whale is rare within the western North Atlantic Ocean. The species is found primarily in deeper tropical and sub-tropical waters (NOAA Fisheries OPR 2012i). There is only one OBIS sighting of the pygmy killer whale in the Study Area. It was observed in 1981 during the CeTAP aerial survey. Two other OBIS sightings were recorded along the shelf-waters, near the Study Area. The pygmy killer whale is considered rare with the Study Area.

Pygmy and Dwarf Sperm Whale (*Kogia breviceps and K. sima*)

Both the dwarf and pygmy sperm whale are most commonly found over the continental shelf edge and slope (NOAA Fisheries OPR 2012j, 2012k). Considered rare in the Mid-Atlantic region, the pygmy sperm whale has no OBIS-recorded sightings within the Study Area. However, three sightings have been recorded in the slope waters near the Study Area. One sighting was recorded in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey, and the two other sightings were recorded in 1998 during the NEFSC Survey. Similar to the pygmy sperm whale, the dwarf sperm whale is also considered rare in the Mid-Atlantic region, including in the Study Area. There are only two sightings recorded in the OBIS database. One sighting occurred in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey. The other sighting occurred in 1998 during the NEFSC Survey. Both species are considered rare within the Study Area.

Melon-Headed Whale (*Peponocephala electra*)

The melon-headed whale prefers warm, deeper, tropical waters (NOAA Fisheries OPR 2012l). The melon-headed whale is considered rare within the Study Area and in all adjacent waters. While no OBIS sightings within the Study Area have been recorded, one sighting was recorded near the

southeastern extent of its boundary. This sighting occurred during the Sargasso 2005 cetacean sightings survey. This species is considered rare within the Study Area

Sowerby's Beaked Whale (*Mesoplodon bidens*)

The Sowerby's beaked whale prefers deep, cold temperate waters within the western North Atlantic (NOAA Fisheries OPR 2012m). During surveys (both aerial and vessel), the various *Mesoplodon* species are difficult to differentiate. OBIS reports eight sightings of the Sowerby's beaked whale within the Study Area. Six have occurred along the shelf with the other two being in the slope waters. The species is considered rare within the Study Area.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

The Blainville's beaked whale is known to occur in deep, offshore waters spanning from tropical to temperate (NOAA Fisheries OPR 2012n). Similar to the Sowerby's beaked whale, the Blainville's beaked whale is difficult to discern from other *Mesoplodon* species during both aerial and vessel surveys. The OBIS data report only one sighting of the Blainville's beaked whale, recorded in 2004 during the NEFSC Mid-Atlantic Marine Mammal Abundance Survey. A second sighting near the northeast extent of the Study Area was logged in 1995 by the NEFSC. The species is considered rare within the Study Area.

Gervais' Beaked Whale (*Mesoplodon europaeus*)

The Gervais' beaked whale can primarily be found in deep warm temperate, tropical, and sub-tropical waters (NOAA Fisheries OPR 2012o). Similar to the Sowerby's beaked whale, the Gervais' beaked whale is difficult to discern from other *Mesoplodon* species during both aerial and vessel surveys. No OBIS sightings of the Gervais' beaked whale within the Study Area or in any adjacent waters have been recorded. This species is considered rare within the Study Area.

True's Beaked Whale (*Mesoplodon mirus*)

The True's beaked whale can primarily be found in deeper, warm temperate waters in the western North Atlantic Ocean (NOAA Fisheries OPR 2012p). Similar to the Sowerby's beaked whale, the True's beaked whale is difficult to discern from other *Mesoplodon* species during both aerial and vessel surveys. The OBIS database does not have any records for sightings of the True's beaked whale within the Study Area. However, of the 20 OBIS sightings for this species, two exist in the waters adjacent to the northwest boundary line of the Study Area. During the NEFSC 1995 survey, one True's beaked whale was spotted along the shelf edge. In 2003, during the Virginia Aquarium Marine Mammal Strandings 1998-2008, the second was reported stranded near approximately 76°N, 37°W. Survey details do not report on the type of stranding. This species is considered rare within the Study Area.

Cuvier's Beaked Whale (*Ziphius cavirostris*)

The Cuvier's beaked whale in can be found in temperate, tropical, and sub-tropical waters. Primarily, this species prefers deeper pelagic waters, being found in water depths greater than 1,000 meters (NOAA Fisheries OPR, 2012q). Of all the beaked whales, the Cuvier's was the most commonly recorded in the OBIS database. The recorded sightings occurred in the shelf and slope waters adjacent to and within the Study Area. The 15 sightings within the Study Area occurred mostly in the slope waters in the northwest portion. While more common than the other beaked whale species, the Cuvier's beaked whale is considered rare within the Study Area.

Northern Bottlenose Whale (*Hyperoodon ampullatus*)

The northern bottlenose whale is considered extremely uncommon/rare within U.S. western North Atlantic Ocean waters. This species prefers cold, deep waters (greater than 2,000 meters), primarily within the temperate to sub-arctic region (NOAA Fisheries OPR 2012r). Only one sighting of this species is in the OBIS database. The observation occurred in 2006 during the NEFSC Right Whale Survey. The northern bottlenose whale is considered rare within the Study Area and adjacent waters.

Pinnipeds

Harbor seal (*Phoca vitulina*)

The harbor seal is considered rare outside of their coastal habitat in the U.S. western North Atlantic Ocean waters. This species prefers temperate coastal habitats, using rock, reefs, beach, or drifting ice on which to haul out. During summer months, this species can primarily occur in the nearshore waters of the Gulf of Maine and into Canadian waters (Waring et al. 2013). Two aerial sightings of this species were recorded offshore Cape Cod, Massachusetts around the 100-meter isobath. No sightings of harbor seals within or adjacent to the Study Area are recorded in the OBIS database. The harbor seal is considered rare within the Study Area and adjacent waters.

Gray seal (*Halichoerus grypus*)

The gray seal is considered rare outside of their coastal habitat in the U.S. western North Atlantic Ocean waters. This species prefers cold water coastal habitats, using rocks, sandbars and icebergs to haul out on. During summer months, this species can primarily be found in the nearshore waters of the Gulf of Maine and into Canadian waters (Waring et al. 2013). No sightings of gray seals within or adjacent to the Study Area are recorded in the OBIS database. The gray seal is considered rare within the Study Area and adjacent waters.

Harp Seal (*Pagophilus groenlandicus*)

The harp seal is considered rare outside its cold water habitat in the North Atlantic, and can be found primarily in the pack ice in the North Atlantic Ocean. During summer months, the harp seal can be found at its Arctic summer feeding grounds. No sightings of harp seals within or adjacent to the Study Area are recorded in the OBIS database. The harp seal is considered rare within the Study Area and adjacent waters.

Hooded seal (*Cystophora cristata*)

The hooded seal is considered rare outside its cold weather habitat. While this species can be found in deep waters, they are primarily found among pack ice. The species has been observed as far south as the Florida and the Caribbean; however, this is unusual as the species survives best in cold water habitats (NOAA Fisheries OPR 2012s). No sightings of hooded seals within or adjacent to the Study Area are recorded in the OBIS database. The hooded seal is considered rare within the Study Area and adjacent waters.

V. TYPE OF AUTHORIZATION REQUESTED

The type of incidental taking authorization that is being requested (i.e., takes by harassment only, takes by harassment, injury and/or death), and the method of incidental taking.

The USGS requests an IHA pursuant to Section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA) for incidental take by harassment during its planned seismic surveys in the western North Atlantic Ocean during late August and early September, 2014.

The operations outlined in Section I have the potential to take marine mammals by harassment. Sounds will be generated by the airguns used during the survey, by the echosounder and sub-bottom profiler, and by general vessel operations. "Takes" by harassment potentially could result when marine mammals near the activities are exposed to the pulsed sounds generated by the seismic sources. The effects will depend on the species of cetacean, the behavior of the animals at the time of reception of the stimulus, and received level of the sound (see Section VII). The proposed survey activities may result in disturbance reactions from any marine mammals within proximity to the source vessel. Based on the planned operations and mitigation measures (see Section XI), no serious injury to any marine mammals is expected, and no lethal takes are expected.

VI. NUMBERS OF MARINE MAMMALS THAT COULD BE TAKEN

By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in [Section V], and the number of times such takings by each type of taking are likely to occur.

The materials for Sections VI and Section VII are combined and presented in reverse order to minimize duplication among sections.

VII. POTENTIAL IMPACT ON SPECIES OR STOCKS

The anticipated impact of the activity upon the species or stock of marine mammal.

The materials for Section VI and Section VII are combined and presented in reverse order to minimize duplication between sections:

- A summary of potential impacts on marine mammals from airgun operations is presented first, as required for Section VII. A more comprehensive review of the relevant background information is included in the PEIS in Sections 3.6.4.3, 3.7.4.3, and 3.8.4.3, and in Appendix E.
- The estimated numbers of marine mammals that could be affected by the proposed survey in the U.S. ECS region off the Atlantic Seaboard during late August and early September, 2014are presented. This section includes a description of the rationale for the USGS's estimates of the potential numbers of harassment "takes" during the planned survey, as required in Section VI.

Summary of Potential Effects of Airgun Sounds

Airguns have the potential to affect marine mammals in a number of ways, including tolerance, masking (of natural sounds including inter- and intra-specific calls), behavioral disturbance, and physiological responses such as temporary or permanent hearing impairment or other non-auditory effects (Richardson et al.1995; Nowacek et al. 2007; Southall et al. 2007; Wright et al. 2007; Tyack 2009).

Physiological impacts, such as permanent threshold shift (PTS) (which could be considered an injurious event) and temporary threshold shift (TTS) (which is not considered an injurious event) could occur as a result of airgun operations (Southall et al. 2007). However, neither physiological impact is expected to occur during the proposed survey due to use of mitigation measures (described below). While the potential for PTS and TTS cannot be entirely excluded, it is highly unlikely (as summarized in the PEIS in Sections 3.6.7, 3.7.7, and 3.8.7) that this auditory impairment would occur as a result of the proposed 2014 survey. It is also highly unlikely that other non-auditory physiological or physical effects would occur as a result of the proposed survey. It is more likely that, should a marine mammal come within proximity to the proposed survey while the seismic airguns are operating, some behavioral disturbance could occur. However, this disturbance is expected to be short-term and localized. Monitoring and mitigation protocols will reduce any potential impacts to marine mammals. As a result of these protocols, it is anticipated that no marine mammals will be exposed to survey sounds that could cause behavioral disturbance.

Tolerance

Tolerance occurs when animals, often within areas commonly exposed to human-generated noise, do not appear to display a response to these human-generated sounds (Richardson et al. 1995). The pulsed sounds from airguns are known to be detectable in the water up to thousands of kilometers away from the source (Nieukirk et al. 2004). Numerous studies have been conducted on the reaction of marine mammals to seismic airgun pulses. Responses vary as marine mammals have been found to both tolerate the noise and to avoid the noise, indicating that response to noise may be related to individual species. Some studies have reported that marine mammals located a few kilometers from the seismic source have shown no apparent reaction to the noise, while other studies report behavioral reactions such as avoidance in both baleen whales and toothed whales (specifically sperm whales) (Malme et al. 1985; Richardson, Würsig, and Greene 1986; Ljungblad et al. 1988; McCauley et al. 2000a). Although individual baleen and toothed whales, as well as (less frequently) pinnipeds, have shown to exhibit behavioral reactions to airgun pulses at certain times, at other times, all three types of marine mammals have exhibited no obvious response. The relative responses of individual baleen whales, toothed whales, and pinnipeds are expected to be quite variable and depend on factors such as species, age, and previous exposures of the animal to human-generated sound.

Masking

Masking occurs when human-generated sounds interfere or obscure the ability of a marine mammal to detect sound signals they would otherwise receive (Richardson et al. 1995). The number of studies specific to the masking effects of pulsed sounds on marine mammal calls is limited. It is expected that those marine mammal species that could potentially be affected by masking may still be able to receive and emit sounds during the relatively quiet periods between the airgun pulses (Simard 2005; Clark and Gagnon 2006). Some baleen whales have been reported to cease calling due to the presence of pulsed sounds; however, other studies have reported that some baleen have increased the consistency of calls to compensate for presence of pulsed sounds (Clark and Gagnon 2006; Di Iorio and Clark 2010). Other studies have reported that whales have continued calling in the presence of seismic activity (Nieukirk et al. 2004; Richardson et al. 1986; Madsen et al. 2002). Small odontocetes predominantly rely on sounds within the higher frequencies. These frequencies are much higher than the dominant frequencies produced by seismic airguns, thereby limiting the potential for masking related to these species. Due to the intermittent nature of seismic airgun pulses, the relatively short timeframe of the proposed 2014 survey, and the large area to be covered during the proposed 2014 survey (reducing repeated seismic pulses

within a small area as is common of seismic surveys), it is expected that masking effect from the seismic pulses will be minor.

Disturbance Reactions

Disturbance effects can be expressed in a variety of ways including both obvious and more subtle reactions. These behavioral disturbance reactions can include (but are not limited to) flight response, changes in diving patters, foraging, and breathing, and avoidance or displacement (Tyack 2009; Nowacek et al. 2007). Temporary exposure and the potential brief reactions to that exposure are not expected to result in any significant disruption to behavioral patterns and will not result in harassment or "taking" (NMFS 2001; National Research Council 2005; Southall et al. 2007). The proposed 2014 survey is not expected to result in any permanent effects to any individuals or populations.

Reactions to sound, if any, depend on the species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson et al. 1995; Wartzok et al. 2004; Southall et al. 2007; Weilgart 2007). If a marine mammal reacts to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (Lusseau and Bejder 2007; Weilgart 2007). Currently, the majority of research and information regarding effects of seismic surveys is focused on individual animals and little information exists regarding effects at the population or community level.

Given the many uncertainties in predicting the quantity and types of impacts of sound on marine mammals, it is common practice to estimate how many mammals would be present within a particular distance of human activities and/or exposed to a particular level of anthropogenic sound. In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically important manner. One of the reasons for this is that the selected distances/isopleths are based on limited studies indicating that some animals exhibited short-term reactions at that specific distance or sound level. The exposure calculations then assume that all animals exposed to this level would react in a biologically significant manner, similar to the few species that were observed exhibiting a reaction at that time.

The sound criteria used to estimate how many marine mammals might be disturbed to some biologically significant degree by seismic survey activities are primarily based on behavioral observations of a few species. Detailed studies have been done on humpback, gray, bowhead, and sperm whales, and on ringed seals. Less detailed data are available for some other species of baleen whales and small-toothed whales, but for many species there are no data on responses to marine seismic surveys.

Baleen whales. Baleen whales generally tend to avoid operating airguns, but avoidance radii are quite variable. Whales often are reported to show no overt reactions to pulses from large arrays of airguns at distances beyond a few kilometers, even though the airgun pulses remain well above ambient noise levels out to much longer distances. However, baleen whales exposed to strong noise pulses from airguns often react by deviating from their normal migration route and/or interrupting their feeding and moving away. Overall, the largest avoidance radii recorded (20 to 30 kilometers) for a reaction to seismic airguns involved migrating bowhead whales (Miller et al. 1999; Richardson et al. 1995). In the cases of migrating gray and bowhead whales, the observed changes in behavior appeared to be of little or no biological consequence to the animals, they simply avoided the sound source by displacing their migration route to

varying degrees, still within the natural boundaries of the migration corridors (Malme et al. 1984; Malme and Miles 1985; Richardson et al. 1995).

Responses of *humpback whales* to seismic surveys have been studied during migration, on summer feeding grounds, and on Angolan winter breeding grounds; there also has been discussion of effects on the Brazilian wintering grounds. During full-scale seismic surveys off Western Australia, avoidance reactions were reported to begin at 5 to 8 kilometers away from the full airgun array and 2 kilometers away from the single airgun. Traveling pods of humpback whales generally remained approximately 3 to 4 kilometers away from the active survey, and more sensitive resting pods of cow-calf pairs maintained an avoidance distance of 7 to 12 kilometers. However, some individual humpback whales, especially males, approached within distances of 100 to 400 meters (McCauley et al. 1998, 2000b).

On summer feeding grounds in southeast Alaska, humpback whales did not exhibit persistent avoidance when exposed to seismic pulses, although some humpback whales did exhibit a "startle" response (Malme et al. 1985). It has been suggested that South Atlantic humpback whales wintering off Brazil may be displaced or even may strand upon exposure to seismic surveys; however, these data were more circumstantial and subject to other explanations (International Association of Geophysical Contractors 2004). Data from subsequent years indicated that no observable direct correlation between strandings and seismic surveys existed.

Currently, there are no data on reactions of *right whales* to seismic surveys. However, results from studies conducted of the closely related *bowhead whale* indicate that responses of this whale can be variable, depending on their activity (migrating vs. feeding). While at summer feeding grounds, bowhead whales showed no reactions to seismic surveys being conducted between 6 and 99 kilometers away (Richardson et al. 1986). More recent studies also indicate that feeding bowhead whales are more tolerant of higher sound levels. Migrating bowhead whales, on the other hand, appear to be more sensitive and responsive to pulsed seismic sounds. Bowhead whale migrating in the Alaskan Beaufort Sea generally show substantial avoidance of seismic surveys (Miller et al. 1999; Richardson et al. 1995).

Reactions of feeding and migrating (not wintering) *gray whales* to seismic sounds also have been studied. In the Bering Sea (off St. Lawrence Island), 50 percent of feeding gray whales were reported to have stopped feeding at received sound pressure levels of 173 dB re 1 µPa on an (approximate) RMS basis, and that 10 percent of feeding whales interrupted feeding at received levels of 163 dB re 1 μPa_{RMS} (Malme et al. 1986, 1988). These findings were generally consistent with the results of studies conducted on larger numbers of gray whales migrating off California and western Pacific gray whales feeding off Sakhalin, Russia.

Studies have not been conducted on other *Balaenoptera* species (i.e., blue, sei, fin, and minke whales); however, these species occasionally have been observed in ensonified areas during various seismic surveys. Observations made during seismic surveys off the United Kingdom between 1997 and 2000 indicate that mysticetes (mainly fin and sei whales) were sighted at a similar rate while large seismic arrays were operating and while they were silent (Stone 2003; Stone and Tasker 2006). Localized avoidance also was observed during this time. Fin/sei whales also have been reported to spend less time submerged during periods when seismic arrays were firing compared to times when silent.

Data on short-term reactions by cetaceans to impulsive noises are not necessarily indicative of long-term or biologically significant effects. Whether impulsive sounds affect reproductive rate or

distribution and habitat use in subsequent days or years is unknown. However, gray whales have continued to migrate annually along the west coast of North America with substantial increases in the population over recent years, despite intermittent seismic exploration (and much ship traffic) in that area for decades. The western Pacific gray whale population did not seem affected by a seismic survey in its feeding ground during a previous year. Bowhead whales have continued to travel to the eastern Beaufort Sea each summer, and their numbers have increased notably

Toothed whales. Little systematic information is available about reactions of toothed whales to sound pulses. However, there are recent systematic studies on sperm whales (i.e., Gordon et al. 2006; Madsen et al. 2006). There is also an increasing amount of information about responses of various odontocetes to seismic surveys based on monitoring studies (i.e., Stone 2003; Smultea et al. 2004; Stone and Tasker 2006). Seismic operators and marine mammal observers on seismic vessels regularly see dolphins and other small-toothed whales near operating airgun arrays but, in general, there is a tendency for most delphinids to show some avoidance of operating seismic vessels (Richardson et al. 2009; Barkaszi, Epperson, and Bennett 2009). In most cases, the avoidance radii for delphinids appear to be small, on the order of 1 kilometer or less, and some individuals show no apparent avoidance. Based on observations from active seismic surveys off the United Kingdom, small odontocetes exhibited greater avoidance to operating airguns than previously reported (Stone et al. 2003; Gordon et al. 2004; Stone and Tasker 2006). The observer data also indicated that small odontocetes were feeding less and were interacting with the vessel less during activity seismic surveys. Captive bottlenose dolphins (and beluga whales) exhibited changes in behavior when exposed to strong, pulsed sounds similar in duration to those typically used in seismic surveys (Finneran et al. 2000, 2002, 2005). However, overall, the animals tolerated high, received levels of sound before exhibiting aversive behaviors. Porpoises, like delphinids, show variable reactions to seismic operations, and reactions apparently depend on species. Harbor porpoises have been reported to show stronger avoidance to seismic operations than Dall's porpoises (Stone 2003; MacLean and Koski 2005; Bain and Williams 2006).

Studies of all three species of sperm whale reported that they show avoidance reactions in general to vessels not operating seismic airguns (Richardson et al. 1995; Würsig et al. 1998; Baird 2005). In studies where sperm whales were exposed to seismic airguns, the species response indicates considerable tolerance to the airgun noise. The whales generally do not show strong avoidance, and they continue to call. Research does indicate; however, that diving and foraging behaviors can be altered upon exposure to airgun sound (Jochens et al. 2008; Miller et al. 2009; Tyack 2009). Specific data on the behavioral reactions of *beaked whales* to seismic surveys is almost non-existent; the majority of information regarding beaked whales is in connection with military sonar events. Most beaked whales are illusive and tend to avoid approaching vessels of other types (Würsig et al. 1998). The species may dive for an extended period when approached by a vessel. However, based on both visual and acoustic observations, some northern bottlenose whales remained in the general area and continued to produce high-frequency clicks when exposed to sound pulses from distant seismic surveys. Most beaked whales would likely show strong avoidance of an approaching seismic vessel, as they would with any other vessel, although this has not been specifically documented.

Overall, odontocete reactions to large arrays of airguns are variable and, at least for delphinids, seem to be confined to a smaller radius than has been observed for the more responsive of the mysticetes and some other odontocetes. Based on available data, ≥170 dB re 1 μPa_{RMS} disturbance criterion (rather than ≥160 dB re 1 μPa_{RMS}) would be appropriate for delphinids. This is based on reaction distances for

delphinids being more consistent with the 170 dB re 1 μPa_{RMS} radius, and delphinids being less responsive than other more responsive cetaceans.

Pinnipeds. Information on the reactions of pinniped species to pulsed seismic airgun sounds is limited. Based on early observations, pinnipeds appear to be quite tolerant of pulsed sounds. Other reports indicate that pinnipeds were tolerant of loud, pulsed sounds when they were strongly attracted to an area for feeding or reproductive purposes (Mate and Harvey 1987; Reeves et al. 1996). In more recent studies, avoidance of pinnipeds during seismic surveys has been reported as being relatively small, within 100 to a few hundred meters. Many seals remained within 100 to 200 meters of the survey track lines while an operating seismic survey passed (Moulton and Lawson 2002). Other observations made during seismic surveys in the Chuckchi and Beaufort Seas reported that pinnipeds were observed less when the seismic airguns were operating than when they were silent (Miller et al. 2005). Overall, behavioral reactions from pinnipeds to pulsed seismic sounds are variable. It is expected that localized avoidance of operating seismic airguns may occur; however, it cannot be guaranteed that these species would fully avoid an operating seismic vessel during active surveys.

Hearing Impairment and other Physical Effects

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very strong sounds. TTS has been demonstrated and studied in certain captive odontocetes and pinnipeds exposed to strong sounds (Southall et al. 2007). However, neither specific occurrences of TTS nor permanent hearing damage (i.e., PTS, in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions) have been documented. Current NMFS policy regarding exposure of marine mammals to high-level sounds is that cetaceans and pinnipeds should not be exposed to impulsive sounds with received levels $\geq$180 dB and 190 dB re 1 μPa_{RMS}, respectively (NMFS 2000). These criteria have been used in establishing the exclusion (shutdown) zones planned for the proposed seismic survey. However, those criteria were established before any information about minimum received levels of sounds necessary to cause auditory impairment in marine mammals existed.

Recommendations for science-based noise exposure criteria for marine mammals, frequency weighting procedures, and related matters were published by Southall et al. (2007). Those recommendations have not, as of late 2013, been formally adopted by the NMFS for use in regulatory processes and during mitigation programs associated with seismic surveys. However, some aspects of the recommendations have been considered in certain EISs and small take authorizations under the MMPA. The NMFS has indicated that they may soon issue new noise exposure criteria for marine mammals that account for the now-available scientific data on TTS, the expected offset between the TTS and PTS thresholds, differences in the acoustic frequencies to which different marine mammal groups are sensitive, and other relevant factors.

The planned monitoring and mitigation measures for this project are designed to detect marine mammals occurring near the airgun array and to avoid exposing them to sound pulses that have the potential, to cause hearing impairment (see Sections XI and XIII). Also, many cetaceans and (to a limited degree) pinnipeds show some avoidance of the area where received levels of airgun sounds are high enough such that hearing impairment could potentially occur. In those cases, the avoidance responses of the animals themselves would reduce or (most likely) avoid any possibility of hearing impairment. Appendix E of the PEIS provides a thorough review of the current knowledge available regarding TTS, PTS, and strandings and mortalities for marine mammals and seismic surveys.

Non-auditory physical effects may also occur in marine mammals exposed to strong underwater, pulsed sound. These non-auditory physiological effects or injuries could include stress, neurological effects, gas bubble formation in the blood or tissues, and other types of organ or tissue damage. It is possible that some marine mammal species (i.e., beaked whales) may be especially susceptible to injury and/or stranding when exposed to strong pulsed sounds. This is likely due to the deep-diving behavior of these species, which could result in a situation similar to "the bends" in humans if the animals are disturbed at depth and rise too quickly to the surface. However, no specific evidence exists regarding the potential for non-auditory effects to occur as a result of seismic surveys. Any effects resulting from the proposed seismic survey are expected to be limited to behavioral avoidance of the seismic vessel, as this reaction appears the most common among most baleen whales, some toothed whales, and some pinnipeds. Therefore, those animals avoiding the seismic survey vessel would be even less likely to incur auditory or non-auditory physical effects. The planned monitoring and mitigation, along with the brief duration of exposure expected, and the deep water environment of the Study Area, would all further reduce the potential for marine mammals to be exposed to pulsed sounds strong enough to cause non-auditory physical effects.

Potential Effects of Multibeam Echosounder and Sub-bottom Profiler Signals

The PEIS included a comprehensive review of potential affects from both MBESs and SBPs (see Sections 3.6.4.3; 3.7.4.3; 3.8.4.3; and Appendix E). The PEIS concluded that the operation of MBESs and SBPs is unlikely to impact odontocetes, mysticetes, or pinnipeds because the intermittent and narrow, downward-directed nature of both acoustic sources would result in no more than one or two brief pinging exposures of any individual animal, due to the movement and speed of the survey vessel.

Number of Marine Mammals that could be Exposed to 160 dB re 1µPA$_{RMS}$

All anticipated takes would be "takes by harassment" of small numbers of marine mammals and are expected to involve only temporary changes in behavior. No injury is expected to result from the proposed 2014 survey due to the proposed mitigation measures discussed below in Section XI. The methods used to estimate the number of marine mammals that could be affected during the proposed survey are described below. In general, the estimates are based on the consideration of the number of marine mammals that could be disturbed by the sounds resulting from the 36-airgun array during the approximately 3,150 kilometers of proposed 2014 survey lines in the U.S. ECS region of the Atlantic seaboard. The sources of data used to determine the "take" estimates are described below.

It is assumed that the airgun array and other sound sources (i.e., MBESs and SBPs) will be operated simultaneously. Therefore, any marine mammal close enough to be affected by an MBES or an SBP would already be affected by the airguns. However, even if the airguns are not operating simultaneously with the other sound sources, as stated earlier, marine mammals are not expected to exhibit anything more than short-term and negligible responses to the MBES and the SBP given the characteristics of the sound (i.e., narrow-downward directed beam) and other considerations as described in Sections 3.6.4.3; 3.7.4.3, 3.8.4.3, and Appendix E of the PEIS. Such reactions, as those expected from an MBES and an SBP alone are not considered to constitute a "taking" (NMFS 2001). Therefore, the "take" estimates described below do not take into account any additional allowance to include any marine mammals that could be affected by sound sources other than airguns.

Basis for Estimating Exposure

Incidental takes were estimated for each species by estimating the likelihood of a marine mammal being present within the expected ensonified area during active 2-D seismic surveys. Expected marine mammal presence in the vicinity of the Study Area during the proposed summer 2014 survey are described in Section IV. Based on the location of the Study Area and the time of year of the proposed 2014 survey, up to 38 marine mammal species have the potential to occur somewhere within the Study Area. Potential exposure is estimated based on the estimated density (animals per unit area) of each species within the Study Area and the amount of area estimated to be within the 160 dB re 1µPa_{RMS} ensonified radius of the 36-airgun array (**Table 1**; **Figure 5**). The estimated 160 dB re 1µPa_{RMS} ensonified zone was determined as described in Section I.

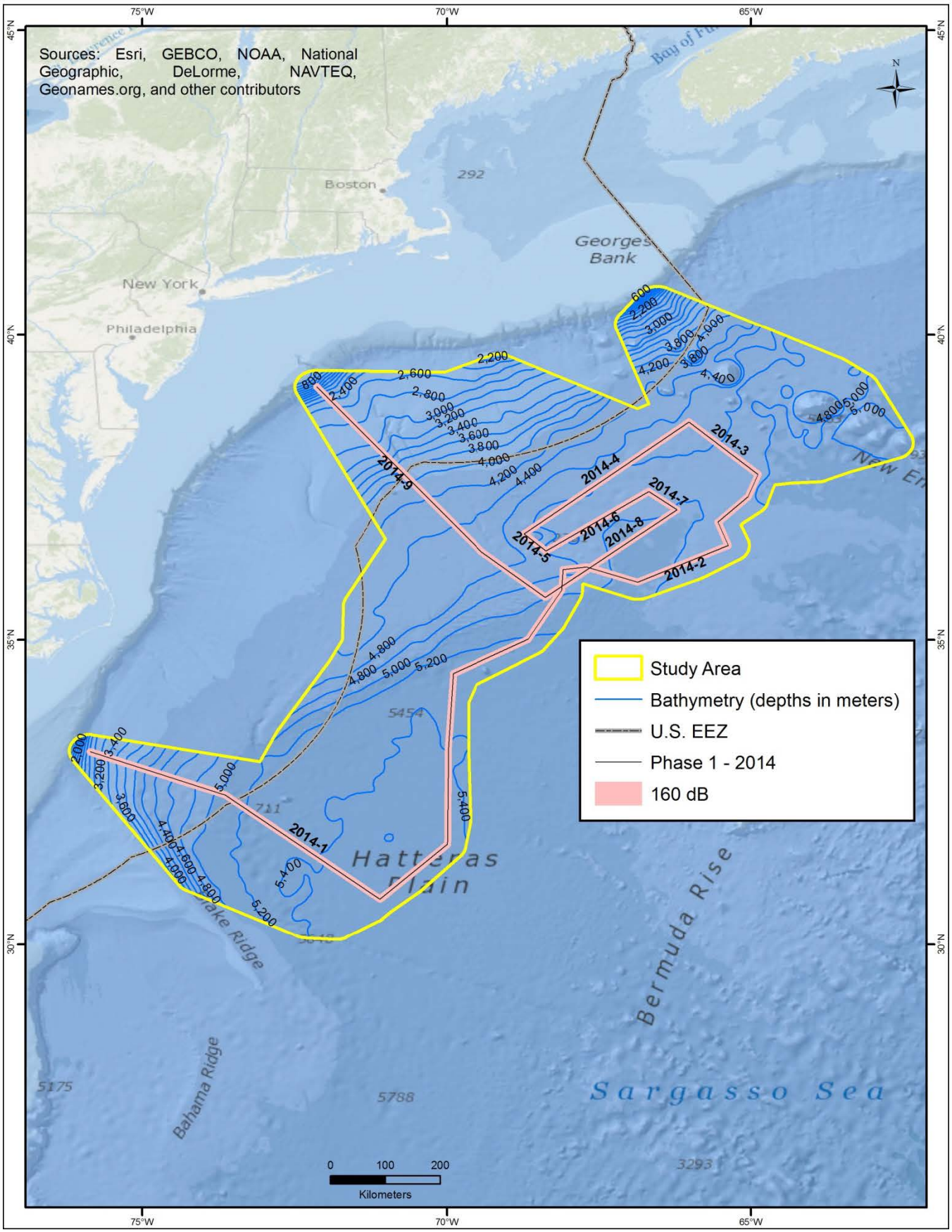


Figure 5 Proposed 2014 Survey – Ensonified Buffer

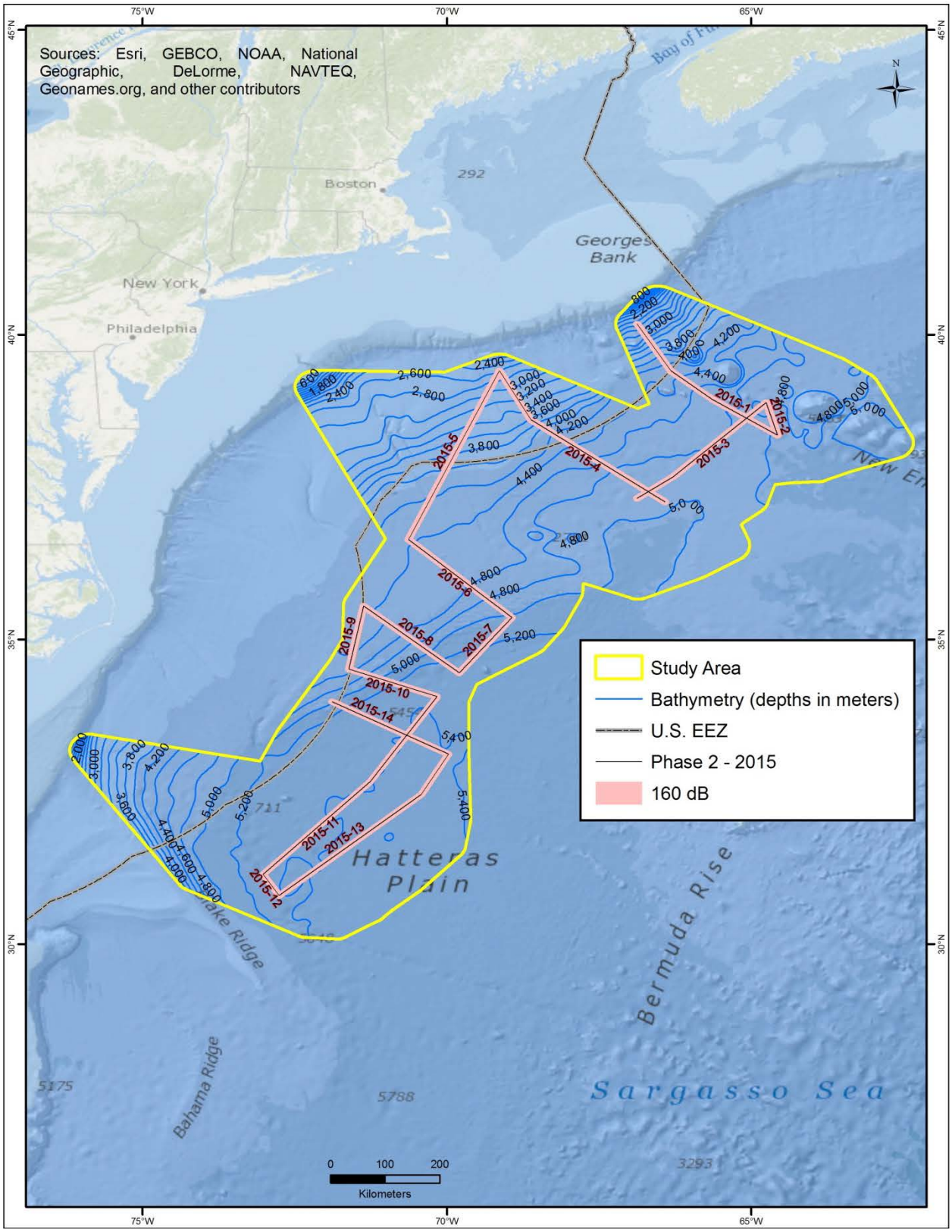


Figure 6 Proposed 2015 Survey – Ensonified Buffer

Density estimates for marine mammals within the vicinity of the Study Area are limited. Density data for species found along the East Coast of the U.S. generally extend slightly outside of the U.S. EEZ. The Study Area, however, extends well beyond the U.S. EEZ, and is well off the continental shelf break. The survey lines for the proposed 2014 survey are located in the far eastern portion of the Study Area, primarily within the area where little to no density data are currently available. It was determined that the best available information for density data (for those species where density data existed) of species located off the U.S. East Coast was housed at the Strategic Environmental and Development Program (SERDP) / National Aeronautics and Space Administration (NASA) / NOAA Marine Animal Model Mapper and OBIS-SEAMAP database. Within this database, the model outputs of all four seasons from the U.S. Department of the Navy Operating Area (OPAREA) Density Estimates (NODE) for the Northeast OPAREA and Southeast OPAREA (Department of the Navy 2007a, 2007b) were used to determine the mean density (animals per square kilometer) for 19 of the 38 marine mammals with the potential to occur within the Study Area. Those species include fin whale, minke whale, Atlantic spotted dolphin, bottlenose dolphin, long-finned and short-finned pilot whale, Pantropical spotted dolphin, Risso's dolphin, Short-beaked common dolphin, striped dolphin, sperm whale, rough-toothed dolphin, dwarf and pygmy sperm whale, and Sowerby's, Blainville's, Gervais', True's, and Cuvier's beaked whales. Model outputs for each season are available in the database. The data from the NODE summer density models, which include the months of June, July, and August, were used as the 2014 survey is proposed to take place between late August and early September. Of the seasonal NODE density models available, it is expected that the summer models are the most accurate and robust as the survey data used to create all of the models were obtained during summer months. The models for the winter, spring, and fall are derived from the data collected during the summer surveys, and therefore are expected to be less representative of actual species density during those seasons.

It should be noted that the mean density for those species was calculated based on the area within the Study Area where density data existed. The outer portion of the Study Area, where the majority of the proposed 2014 survey lines are located, was classified as "no data" in the database. Therefore, the density estimates that were used are based on species density for a portion of the Study Area. Due to the lack of more comprehensive and available data, the NODES data have been determined to be the best available data for that area. The density data likely do not extend out to the eastern portion of the Study Area as marine mammal surveys generally do not occur this far offshore. Therefore, there is a general lack of information in this region.

For those species that did not have density model outputs within the SERDP/NASA/NOAA and OBIS-SEAMAP database, or those species with density outputs that did not extend into the Study Area at all (i.e., all four pinniped species, or the sei whale), but for which OBIS sightings data within or adjacent to the Study Area exists, a *Requested Take Authorization* for the mean group size of the species is included. Mean group sizes were determined based on data reported from the CeTAP surveys (CeTAP 1982).

The estimated numbers of animals potentially exposed to sound during the proposed 2014 survey were determined using the 160 dB re 1µPa_{RMS} threshold criterion for all cetaceans and pinnipeds. It is assumed that any marine mammals that are exposed to airgun sounds within this threshold could change their behavior sufficiently to be considered "taken by harassment." Table 3 shows the density estimates for each species as described above and the estimated numbers of individual marine mammals that could be exposed to ≥160 dB re 1µPa_{RMS} during the active 2-D seismic survey. This estimate assumes that the individual animals do not move away from the seismic survey vessel, therefore, resulting in exposure. As

stated earlier, for species for which densities were unavailable, but for which OBIS sightings within or adjacent to the Study Area exist, a *Requested Take Authorization* for the mean group size of the species is included.

It should be noted, that unlike previous USGS, NSF, and L-DEO seismic surveys aboard the *R/V Langseth*, the proposed survey will be conducted as essentially one continuous line. The survey will not be conducted in a pattern of parallel lines and will not include full turns of the vessel. Therefore, the ensonified area for the proposed survey does not include a contingency factor (typically 25%) in line-kilometers. The proposed survey also is not expected to shut down the airguns, only to power-down the airguns, should a marine mammal enter within the 160 dB re 1µPa_{RMS} EZ. Given this, the ensonified area for the single mitigation gun would be much smaller than that of the full array (see Table 1). Therefore, the use of the full 160 dB re 1µPa_{RMS} ensonified area for the entire 3,150 kilometers of survey lines is expected to overestimate of the actual ensonified area should the single mitigation airgun need to be used at any time. It is assumed that the estimates of the numbers of individual marine mammals that could be exposed to sounds at 160 dB re 1µPa_{RMS} are overall precautionary due to the overestimated ensonified area and the estimation of species presence within the large Study Area, and are likely to overestimate the actual number of marine mammals that could be exposed. These estimates assume that there would be no weather, equipment, or mitigation delays, which is highly unlikely.

Note that although the survey track is continuous through the turns and no mitigation gun will be necessary. However, the mitigation airgun may be used in the event of minor, short duration equipment maintenance. Longer maintenance or repair periods (greater than two hours) of the seismic equipment would warrant complete shut-down of the seismic source, including the mitigation gun. The normal ramp-up procedures would be followed at the completion of these longer shut-down periods.

Table 3: Densities and Estimates of Possible Numbers of Individuals That Could be Exposed to 160 dB re 1 μPA_{RMS} During Each of Proposed Summer (June, July, August) 2014 and 2015 2-D Seismic Surveys

Species	Mean Density (#/km^2)[a]	Ensonified Area (km^2)	Calculated Take[b]	% of Regional Population[c]	Requested Level B Take Authorization
Mysticetes					
Fin Whale	0.0000610	36,600	3	0.0113	3
Humpback Whale	N/A	36,600	0	0.0259	3[d]
Minke Whale	0.0000360	36,600	2	0.0014	2
North Atlantic Right Whale	N/A	36,600	0	0.6593	3[d]
Blue Whale	N/A	36,600	0	0.2339	2[d]
Bryde's Whale	N/A	36,600	0	N/A	3[d]
Sei Whale	N/A	36,600	0	0.0291	3[d]
Odontocetes					
Atlantic White-sided Dolphin	N/A	36,600	0	0.1106	54[d]
Atlantic Spotted Dolphin	0.0288400	36,600	1056	2.3616	1056
Bottlenose Dolphin	0.0066470	36,600	244	0.3147	244
Long-Finned Pilot Whale	0.0190400	36,600	697	0.0894	697
Short-Finned Pilot Whale	0.0190400	36,600	697	0.0894	697
Pantropical Spotted Dolphin	0.0197600	36,600	724	21.7222	724
Risso's Dolphin	0.0093180	36,600	342	1.8740	342
Shorted-beaked Common Dolphin	0.0055320	36,600	203	0.1170	203
Striped Dolphin	0.1343000	36,600	4,916	8.9697	4,916
Sperm Whale	0.0022510	36,600	83	0.6293	83
Killer whale	N/A	36,600	0	N/A	7[d]
Clymene Dolphin	0.0093110	36,600	0	N/A	346
Spinner Dolphin	N/A	36,600	0	N/A	65[d]
Rough-Toothed Dolphin	0.0004260	36,600	16	5.5351	16
Fraser's Dolphin	N/A	36,600	0	N/A	100[d]
Harbor Porpoise	N/A	36,600	0	0.0010	5[d]
False Killer Whale	N/A	36,600	0	N/A	15[d]
Pygmy Killer Whale	N/A	36,600	0	N/A	25[d]
Dwarf Sperm Whale	0.0008970	36,600	33	0.8719	33
Pygmy Sperm Whale	0.0008970	36,600	33	0.8719	33
Melon-Headed Whale	N/A	36,600	0	N/A	100[d]
Sowerby's Beaked Whale	0.0022870	36,600	84	1.1844	84
Blainville's Beaked Whale	0.0022870	36,600			
Gervais' Beaked Whale	0.0022870	36,600			
True's Beaked Whale	0.0022870	36,600			
Cuvier's Beaked Whale	0.0022870	36,600		1.2860	
Northern Bottlenose Whale	N/A	36,600	0	N/A	2[d]
Pinnipeds					
Harbor seal	0	36,600	0	N/A	0
Gray seal	0	36,600	0	N/A	0
Harp seal	0	36,600	0	N/A	0
Hooded Seal	0	36,600	0	N/A	0

[a] Source: OBIS-SERDP-Navy NODE 2007a and 2007b (for those species where density data were available).
[b] Calculated take is estimated density multiplied by the 160-db ensonified area. These calculations do not include any contingency as the survey will be conducted as one continuous line.
[c] Requested takes expressed as percentages of the larger regional populations, where available; where not available (most odontocetes–see Table 2), Draft 2013 SAR population estimates were used; N/A means not available
[d] Requested take authorization was increased to average group size for species for which densities were not available but have been sighted near or have the potential to be observed within the Study Area. Average group size from CeTAP 1984.

Table 4: Densities and Estimates of Possible Numbers of Individuals That Could be Exposed to 160 dB re 1 μPA_{RMS} During Spring (March, April, May) 2015 2-D Seismic Surveys

Species	Mean Density (#/km^2)[a]	Ensonified Area (km^2)	Calculated Take[b]	% of Regional Population[c]	Requested Level B Take Authorization
Mysticetes					
Fin Whale	0.0000600	36,600	3	0.113	3
Humpback Whale	0.0010170	36,600	38	0.3276	38
Minke Whale	0.0000350	36,600	2	0.0014	2
North Atlantic Right Whale	N/A	36,600	0	0.6593	3[d]
Blue Whale	N/A	36,600	0	0.2339	2[d]
Bryde's Whale	N/A	36,600	0	N/A	3[d]
Sei Whale	N/A	36,600	0	0.0291	3[d]
Odontocetes					
Atlantic White-sided Dolphin	N/A	36,600	0	0.1106	54[d]
Atlantic Spotted Dolphin	0.0285700	36,600	1046	2.3393	1046
Bottlenose Dolphin	0.0069560	36,600	255	0.3289	255
Long-Finned Pilot Whale	0.0108000	36,600	396	0.0408	396
Short-Finned Pilot Whale	0.0108000	36,600	396	0.0508	396
Pantropical Spotted Dolphin	0.0194900	36,600	714	21.422	714
Risso's Dolphin	0.0092150	36,600	338	1.8520	338
Shorted-beaked Common Dolphin	0.0053940	36,600	198	0.1141	198
Striped Dolphin	0.1330000	36,600	4,868	8.8817	4,868
Sperm Whale	0.0019050	36,600	70	0.5307	70
Killer whale	N/A	36,600	0	N/A	7[d]
Clymene Dolphin	0.0093110	36,600	341	N/A	341
Spinner Dolphin	N/A	36,600	0	N/A	65[d]
Rough-Toothed Dolphin	0.0004200	36,600	16	5.9041	16
Fraser's Dolphin	N/A	36,600	0	N/A	100[d]
Harbor Porpoise	N/A	36,600	0	0.00010	5[d]
False Killer Whale	N/A	36,600	0	N/A	15[d]
Pygmy Killer Whale	N/A	36,600	0	N/A	25[d]
Dwarf Sperm Whale	0.0008850	36,600	33	0.8719	33
Pygmy Sperm Whale	0.0008850	36,600	33	0.8719	33
Melon-Headed Whale	N/A	36,600	0	N/A	100[d]
Sowerby's Beaked Whale	0.0021370	36,600	79	1.1139	79
Blainville's Beaked Whale		36,600			
Gervais' Beaked Whale		36,600			
True's Beaked Whale		36,600			
Cuvier's Beaked Whale		36,600		1.2094	
Northern Bottlenose Whale	N/A	36,600	0	N/A	2[d]
Pinnipeds					
Harbor seal	0	36,600	0	N/A	0
Gray seal	0	36,600	0	N/A	0
Harp seal	0	36,600	0	N/A	0
Hooded Seal	0	36,600	0	N/A	0

[a] Source: OBIS-SERDP-Navy NODE 2007a and 2007b (for those species where density data were available).
[b] Calculated take is estimated density multiplied by the 160-db ensonified area. These calculations do not include any contingency as the survey will be conducted as one continuous line.
[c] Requested takes expressed as percentages of the larger regional populations, where available; where not available (most odontocetes–see Table 2), Draft 2013 SAR population estimates were used; N/A means not available
[d] Requested take authorization was increased to average group size for species for which densities were not available but have been sighted near or have the potential to be observed within the Study Area. Average group size from CeTAP 1984.

It also should be noted that as summarized from the PEIS in the above section, "Summary of Potential Airgun Effects," delphinids appear to be less responsive to airgun sounds than some mysticetes. The 160 dB re 1µPa_{RMS} criterion that the NMFS currently uses to determine potential Level B harassment to all cetaceans was based on recorded reactions of gray and bowhead whales. For delphinids and pinnipeds, a 170 dB re 1µPa_{RMS} disturbance criterion may be more appropriate. Based on this, the estimates of potential "takes by harassment" presented in Table 3 would, therefore, be considered precautionary. Note that the ensonified area (36,600 km^2) shown in Table 3 is calculated for the 2014 survey. The 2015 survey is expected to ensonify an almost identical area (to within 2 %); therefore takes requested are identical for each of the two years. However, the 2015 survey may be scheduled for an earlier time slot. Table 4 indicates the number of takes that would be expected were the survey to be scheduled in the spring rather than summer. The data suggest that spring takes would be higher for only two species: Humpback Whale and Bottlenose Dolphin. Spring takes would be fewer for nine species, and unchanged for the remaining species.

Potential Number of Marine Mammals Exposed

The potential number of different individual marine mammals that could be exposed to airguns at or exceeding 160 dB re 1µPa_{RMS} can be determined using the total area that will be located within the 160-dB radius at any one point during the entire survey. In many seismic surveys, this total marine area includes overlap, as seismic surveys are often conducted in parallel survey lines where the ensonified areas of each survey line will overlap. The proposed 2014 survey lines, however, will not have overlap as the individual line segments of the complete 2014 proposed survey line do no run parallel to each other. The entire survey could be considered one continual survey line with slight turns (no more than 90 degrees) between each line segment (see **Figures 5** and **6**). During the proposed 2014 survey, the seismic vessel will continue on the extensive survey line path, not staying within a smaller defined area as most seismic surveys do. Therefore, due to the structure of the proposed 2014 survey, there is a potential for one marine mammal to be exposed to the airgun sounds more than once. It is expected however that, if an individual is exposed at least once at any one point during the survey, that animal is more likely to avoid the survey vessel should it encounter the survey vessel farther down the survey line, reducing the likelihood of a second exposure.

The number of potential individuals exposed to airgun sounds ≥160 dB re 1µPa_{RMS} were determined by multiplying each expected species density (for those species that had density data) by the total ensonified area for the entire 3,150 kilometers of the survey line. The total area expected to be ensonified was determined by creating the 160-dB buffer around the entire survey line (see Table 1). This was done using ESRI ArcGIS. Using this approach, a total of 33,193 square kilometers will fall within the 160-dB isopleth throughout the course of the proposed 2014 survey. This approach does not allow for turnover in the marine mammal populations in the area, therefore, the actual number of marine mammals could be underestimated. However, it is expected that the line kilometers used to calculate the potential exposures and the fact that these calculations assume that no marine mammals would move away from the track line during active surveys before the received sound levels reach 160 dB re 1µPa_{RMS} result in an overestimation of potential individual exposures.

The total number of individual animals that could be exposed to received levels of seismic sounds ≥160 dB re 1µPa_{RMS} during the entire proposed 2014 survey is 9,866 (Table 3). That total includes 97 cetaceans listed as ***Endangered*** under the ESA, including 3 fin whales (0.011 percent of the regional population), 3 humpback whales (0.026 percent of the regional population), 3 North Atlantic right whales

(0.66 percent of the regional population), 2 blue whales (0.234 percent of the regional population), 3 sei whales (0.029 percent of the regional population), and 83 sperm whales (0.629 percent of the regional population).

Most of the cetaceans (89.2 percent) potentially exposed are delphinids. The most common species in the area are expected to be the striped dolphin (4,916 estimated individuals [8.97 percent of the regional population]), Atlantic spotted dolphin (1056 estimated individuals [2.36 percent of the regional population]), and Pantropical spotted dolphin (724 estimated individuals [21.72 percent of the regional population]). No "takes" of pinnipeds are expected due to a lack of species observations within the Study Area, the great distance offshore , and the extreme depth of the Study Area, as these species are primarily found in coastal waters. It should be noted that the regional populations for each species are the populations reported in the 2013 NMFS Stock Assessment Report (SAR) for species populations within U.S. waters. Therefore, population percentages may be underestimated for actual population sizes that would include waters outside the U.S. EEZ.

Conclusions

As stated earlier, the proposed 2014 survey will consist of operating a seismic airgun array that will introduce pulsed intermittent noise into the marine environment. During this time, both an MBES and an SBP will be operating simultaneously. During the survey, the R*/V Langseth* will be towing a full 36-airgun array with a total volume discharge of approximately 6,600 in^3. Regular vessel operations also are likely to produce sound within the marine environment; however, continuous noise sources such as this are not commonly known to affect marine mammals to the point of "taking." In addition, no takes are expected to result from the operation of the echosounder operations given the discussion found in Sections 3.6.4.3, 3.7.4.3, 3.8.4.3, and Appendix E of the PEIS.

Cetaceans. Sections 3.6.7 and 3.7.7 of the PEIS concluded that with the implementation of the proposed monitoring and mitigation measures, unavoidable impacts to mysticetes and odontocetes (in the Northwest Atlantic Detailed Analysis Area and Mid-Atlantic Ridge Qualitative Analysis Area) are expected to be limited to short-term behavioral disturbance and short-term localized avoidance of the area where airguns are operating. These impacts will result in only a small number of Level B behavioral effects. Level A effects are highly unlikely, and seismic operations are unlikely to adversely affect any ESA-listed species.

Pinnipeds. Section 3.8.7 of the PEIS concluded that pinnipeds are absent or rare in most locations where seismic surveys occur. This is true for the proposed 2014 surveys. However, with the implementation of the proposed monitoring and mitigation measures, impacts to pinnipeds are expected to be limited to behavioral disturbance and, in some cases, localized avoidance of the area where airguns are operating. Level A effects are highly unlikely. Due to the lack of species presence data within the Study Area and the species' preferences for more coastal waters, the proposed survey is not expected to encounter any pinniped species.

This IHA application presents the estimated potential number of marine mammals that could be exposed to pulsed seismic airgun sounds during the proposed 2014 survey. Based on this, "take authorizations" by Level B harassment also have been requested for each species. Overall, the requested take authorizations represent a small percentage of the overall U.S. regional population for each species (see Table 3). Exposure estimates for only one species, the pantropical spotted dolphin, represent greater than 20 percent of the regional population of any species with 656 requested takes. However, it is expected that these, as with the estimates for all of the potential species exposures, are overestimates for

the reasons outlined previously. It should also be noted that any bottlenose dolphins potentially encountered during the proposed 2014 survey would primarily be from the offshore morphotype population. This morphotype is genetically distinct from the coastal morphotype populations, which are the populations primarily affected by the recent 2013 UME. Therefore, the potential for Level B harassment of 221 individuals of the offshore bottlenose dolphin morphotype, which represents 0.28 percent of the regional population, would not further affect the potentially vulnerable population of the coastal morphotype.

Overall, the relatively short-term exposures to any marine mammals are unlikely to result in any long-term negative consequences to either individual and animals or populations.

VIII. ANTICIPATED IMPACTS ON SUBSISTENCE USES

The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.

There is no legal subsistence hunting for marine mammals in the western North Atlantic, so the proposed activities will not have any impact on the availability of the species or stocks for subsistence users.

IX. ANTICIPATED IMPACTS ON HABITAT

The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.

The proposed seismic survey would not result in any permanent impact on habitats used by marine mammals or to their food sources. The main impact on marine mammals associated with the proposed 2014 survey activity will be temporarily elevated noise levels and the associated direct effects, as discussed in Section VII, above. Seismic airguns also have the potential to affect fish and invertebrates that serve as prey for marine mammal species. The effects of airguns on fish and invertebrates are reviewed in the PEIS in Sections 3.2.4.3 and 3.3.4.3, and in Appendix D. The PEIS concluded that seismic airguns could have both direct and indirect effects on fish and invertebrate species, including behavioral changes and other non-lethal, temporary impacts, and injury or mortal impacts on individual fish located within direct proximity to an active high-energy acoustic source. However, significant impacts from the proposed 2014 survey to fish or invertebrate populations are not anticipated.

X. ANTICIPATED IMPACT OF LOSS OR MODIFICATION OF HABITAT ON MARINE MAMMALS

The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.

The proposed 2014 survey is not expected to have any habitat-related effects with the potential to result in significant or long-term impacts on either individual marine mammals or their populations. This is a result of the limited duration of the proposed 2014 survey (approximately 19 days) and the large area

the survey will cover. There is a potential that the small number of marine mammals present within the vicinity of the survey vessel while the full airgun array is operating would be temporarily displaced as much as a few kilometers. However, as stated earlier, the proposed 2014 survey is not operating in a small, defined location. The proposed 3,150 kilometers of survey lines are not parallel and the seismic vessel will continuously move along that line. This reduces the potential to create a specific area offshore with repeated seismic activity that marine mammals may avoid.

XI. MITIGATION MEASURES

The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Marine mammals are known to occur within the Study Area. To minimize potential impacts that could occur to species and/or stocks, airgun operations will be conducted in accordance with the MMPA and the ESA. This will include obtaining permission for incidental harassment of incidental "takes" of marine mammals and other federally listed species. The proposed activities will take place both within the U.S. EEZ and in International Waters.

The following subsections outline the proposed mitigation measures that will be followed during the proposed 2014 survey. The procedures described here are based on protocols used during previous L-DEO seismic research cruises as approved by the NMFS.

Planning Phase

As discussed in the PEIS (Section 2.4.1.1), mitigation of potential impacts from the proposed survey begins during the planning phase. The USGS worked with L-DEO and NSF to identify potential time periods to carry out the survey, taking into consideration key factors such as environmental conditions (i.e., the seasonal presence of marine mammals). As most marine mammal species are expected to occur in the Study Area year-round, altering the timing of the proposed 2014 survey from summer months would result in no net benefits to these species. After consideration of what energy source level was necessary to achieve the research goals, USGS determined that the standard *R/V Langseth* 36-airgun array with a total volume of approximately 6,600 in^3 was appropriate.

Proposed Exclusion Zones

Based on L-DEO's model (Diebold et al. 2010 and Appendix H of the PEIS), received sound levels have been predicted for the proposed 2014 survey. The predicted received sound levels are a function of distance from the airguns for both the full 36-airgun array and the single 1900LL 40-in^3 airgun (mitigation gun), which would be used during power-downs (see **Figures 3** and **4**). This modeling approach uses ray tracing for the direct wave traveling from the array to the receiver and its associated source ghost (reflection at the air-water interface in the vicinity of the array), in a constant-velocity half-space (infinite homogeneous ocean layer, unbounded by a seafloor). In addition, propagation measurements of pulses from the 36-airgun array at a tow depth of 6 meters have been reported in approximately 1,600 meters water depth (deep water), 50 meters depth (shallow water) and a slope site (intermediate water depth) in the Gulf of Mexico in 2007–2008 (Tolstoy et al. 2009; Diebold et al. 2010).

For deep water and intermediate water depth cases, these field measurements cannot be used readily to derive mitigation radii. At these sites, the calibration hydrophone was located at a roughly constant depth of 350 to 500 meters, which may not intersect all the SPL isopleths at their widest point from the sea surface down to the maximum relevant water depth for marine mammals of approximately 2,000 meters. Figures 2 and 3 in Appendix H of the PEIS show how the values along the maximum SPL line that connects the points where the isopleths attain their maximum width (providing the maximum distance associated with each sound level) may differ from values obtained along a constant depth line. At short ranges, where the direct arrivals dominate and the effects of seafloor interactions are minimal, the data recorded at the deep and slope sites are suited for comparison with modeled levels at the depth of the calibration hydrophone. At larger ranges, the comparison with the mitigation model—constructed from the maximum SPL through the entire water column at varying distances from the airgun array—is the most relevant. The results are summarized below.

Comparisons at short ranges between sound levels for direct arrivals recorded by the calibration hydrophone and model results for the same array tow depth are consistent (Figures 12 and 14 in Appendix H of the PEIS). Consequently, isopleths falling within this domain can be reliably predicted by the L-DEO model, while they may be imperfectly sampled by measurements recorded at a single depth. At larger distances, the calibration data show that seafloor reflected and sub-seafloor refracted arrivals dominate, while the direct arrivals become weak and/or incoherent (Figures 11, 12 and 16 in Appendix H of the PEIS). Aside from local topography effects, the region around the critical distance (approximately 5 kilometers on Figures 11 and 12, and approximately 4 kilometers in Figure 16 in Appendix H of the PEIS) is where the observed levels rise close to the mitigation model curve. However, the observed sound levels are found to fall almost entirely below the mitigation model curve (Figures 11, 12, and 16 in Appendix H of the PEIS). Thus, analysis of the Gulf of Mexico calibration measurements demonstrates that although simple, the L-DEO model is a robust tool for estimating mitigation radii.

During the proposed 2014 survey, the proposed seismic operations will occur entirely in deep water (i.e., greater than 1,000 meters). Therefore, for the purposes of the proposed 2014 survey, only deep-water radii were predicted. For the full 36-airgun array, the deep-water radii were obtained from 9-meter tow depth L-DEO model results to a maximum water depth of 2,000 meters.

Measurements have not been reported for the single 40-in^3 airgun. The 40-in^3 airgun fits under the PEIS low-energy sources (i.e., any towed acoustic source whose receive level is ≤180 dB re 1 μPa_{RMS} at 100 meters from the source, including any single airgun with a volume ≤ 425 in^3). In the PEIS (Section 2.4.2), Alternative B (the Preferred Alternative) conservatively applies a 100-meter EZ for all low-energy acoustic sources in water depths greater than 100 meters. This approach is adopted here for the single Bolt 1900LL 40-in^3 airgun that would be used during power-downs. In addition, L-DEO model results are used to determine the 160- and 190- dB radii for the 40-in^3 airgun in deep water.

Table 1 shows the modeled distances for both the 36-airgun array and the single mitigation gun at which the 160, 160, and 190 dB re 1 μPa_{RMS} received levels are expected to be reached. The 180-dB re 1 μPa_{RMS} distance is the safety criterion as specified by NMFS (2000) for cetaceans. If marine mammals or sea turtles are detected within, or about to enter, the appropriate exclusion zone, the airguns would be immediately powered down (or shut down if necessary).

New, detailed recommendations for science-based noise exposure criteria have been presented by Southall et al. (2007). The USGS is aware that NOAA is in the process of revising the current guidance for marine mammals regarding acoustic exposure. However, at the time of this IHA application, that

guidance has not been finalized. The USGS is prepared to revise its procedures for estimating the number of marine mammals "taken," EZ's, etc., as may be required by any new guidelines that may result.

Mitigation during Operations

Mitigation measures that will be adopted during the proposed survey include: (1) power-down procedures, (2) ramp-up procedures; and (3) special procedures for situations of species of particular concern.

Power-down Procedures

A power-down involves reducing the number of airguns operating such that the radius of the 180-dB (or 190-dB) zone is decreased to the extent that an observed marine mammal(s) is (are) no longer observed within the EZ. As the proposed survey does not include any full turns (only 90-degree turns maximum), the seismic airgun array will continue to operate at full power between line segments. The survey will be conducted as the segments are one continuous line. During a power-down, only one airgun will be operating. The continued operation of one-airgun is intended to alert any marine mammals of the presence of the seismic vessel.

If a marine mammal is detected within, or is likely to enter the EZ, the airgun array would be powered down immediately. During a power-down situation of the full air-gun array, only a 40-in^3 airgun will be operated. Following a power-down situation, airgun activity will not resume until the marine mammal has cleared the EZ. The animal will be considered clear of the EZ if it:

- is visually observed to have left the EZ; or
- has not been seen within the EZ for 15 minutes in the case of small odontocetes and pinnipeds; or
- has not been seen within the EZ for 30 minutes in the case of mysticetes and large odontocetes including sperm, pygmy sperm, dwarf sperm, and beaked whales; or
- the vessel has moved outside the applicable EZ in which the animal in question was last seen.

Following a power-down and subsequent animal departure from the EZ as described above, the airgun array would resume full operations. Based on previous *R/V Langseth* marine seismic surveys, it has been determined that following a power-down, ramp-up from the single mitigation gun is not necessary as the single mitigation gun serves to warn any marine mammals within the vicinity of the survey of the seismic activities underway. It has also been determined that the ramp-up procedures may unnecessarily extend the length of the survey time needed to collect the seismic data. Previous surveys conducted by L-DEO and NSF in consultation with the NMFS have concluded that undergoing ramp-up procedures following an extended power-down is not necessary. Therefore, this IHA application does not include this practice as part of the monitoring and mitigation plan.

If an animal is observed within the smaller designated EZ for the single airgun (see Table 1), the airguns will be completely shut down. Airgun operation will not be resumed until the above conditions are met, as applicable.

Shutdown Procedures

Operating airgun(s) will be shut down if a marine mammal is observed within or approaching the EZ for the single airgun. During a shutdown, all operating airguns will be turned off immediately. Airgun activity will not resume until the marine mammal(s) has cleared the EZ for the full array, as described above under "Power-down Procedures."

Ramp-up Procedures

A ramp-up procedure will be followed when starting the airguns at the beginning of seismic operations or anytime the entire array has been shut down for a specified period of time. Based on other surveys conducted by L-DEO using the *R/V Langseth* and using an airgun array of similar size as the proposed 2014 survey, a period of approximately 10 minutes is proposed for the 2014 survey. Ramp-up will not occur if an observed marine mammal has not cleared the EZ as described above.

Ramp-up will consist of beginning with the smallest airgun in the array (40 in^3). Airguns will then be added in a sequence such that the source level of the array will increase in steps not exceeding 6 dB per 5-minute period. A 36-airgun array is expected to take approximately 30 minutes to achieve full operations. During the ramp-up, NMFS-approved Protected Species Visual Observers (PSVOs) will monitor the EZ, and if a marine mammal is sighted, a power-down or shutdown will be implemented, as applicable, as though the full array were operating.

Ramp-up may not be initiated unless the full EZ is visible to the PSVOs for no less than 30 minutes, whether conducted in daytime or nighttime. Ramp-up may commence even if the entire EZ is not visible for 30 minutes if at least one airgun (40 in^3 or smaller) has been operating during the interruption of seismic survey operations. Therefore, it is not expected that the full airgun array will be ramped-up from a completion shutdown at night or during poor visibility conditions (i.e., thick fog). However, if one airgun has continued during a power-down period, ramp up to full power will be permissible at night or in poor visibility conditions. This is based on the assumption that marine mammals would be alerted to the presence of the seismic vessel by the continually operating mitigation airgun. Ramp-up of the airguns will not be initiated if a marine mammal is present within the EZ of the airgun array to be operated.

As stated above under "Power-down Procedures," based on previous *R/V Langseth* marine seismic surveys, it has been determined that following a power-down, ramp-up from the single mitigation gun is not necessary as the single mitigation gun serves to warn any marine mammals within the vicinity of the survey of the seismic activities underway. Therefore, this IHA application does not include this practice as part of the monitoring and mitigation plan.

Special Procedures for Situations or Species of Concern

It is unlikely that a North Atlantic right whale (NARW) will be encountered during the proposed survey. However, if a NARW is visually identified at any distance from the vessel during seismic operations, the airguns will be shut down immediately and remain off for a minimum of 30 minutes after the animal is beyond visual range before resuming with ramp-up. This is due to the species rarity and conservation status. In addition, it is unlikely that concentrations (groups of 6 or more individuals) of humpback, fin, sperm, blue, or sei whales will be encountered, but if so, they will be avoided.

XII. PLAN OF COOPERATION

Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses. A plan must include the following:

(i) A statement that the applicant has notified and provided the affected subsistence community with a draft plan of cooperation;

(ii) A schedule for meeting with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the operation or the plan of cooperation;

(iii) A description of what measures the applicant has taken and/or will take to ensure that proposed activities will not interfere with subsistence whaling or sealing; and

(iv) What plans the applicant has to continue to meet with the affected communities, both prior to and while conducting activity, to resolve conflicts and to notify the communities of any changes in the operation.

Not applicable. The proposed activity will take place in the western North Atlantic, and no activities will take place in or near a traditional Arctic subsistence hunting area.

XIII. MONITORING AND REPORTING PLAN

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

The USGS proposes to sponsor marine mammal monitoring during the proposed 2014 survey in order to implement the proposed mitigation measures that require real-time monitoring and to satisfy the anticipated monitoring requirements of the IHA.

The proposed Monitoring and Reporting Plan for the USGS is described below. The USGS understands that this Monitoring and Reporting Plan will be subject to review by the NMFS and that refinements may be required.

The monitoring work described in association with the proposed 2014 survey has been planned as a self-contained project, independent of any other related monitoring projects that may be occurring

simultaneously in the same regions. The USGS is prepared to discuss coordination of its monitoring program with any related work that subsequently might be conducted by other groups insofar as it is practicable and desirable.

Vessel-based Visual Monitoring

Vessel-based PSVO observations will take place during daytime airgun operations and before and during start-ups of airguns during daytime or nighttime. Airgun operations will be suspended when marine mammals are observed within, or about to enter, the designated EZ where there is concern about potential effects on hearing or other physical effects (see Section XI). PSVOs also will be on watch for marine mammals within the EZ for at least 30 minutes prior to the start of seismic operations following an extended shutdown. PSVOs will remain on watch during daytime periods when the seismic airguns are not operating in order to compare animal abundance and behaviors during times of operation and no operation.

In total, five PSVOs will be deployed aboard the *R/V Langset*. Two PSVOs will remain on watch during daytime seismic operations, with at least one PSVO remaining on watch during meal times and restroom breaks. PSVO shifts will last no longer than four hours at a time. The *R/V Langseth* crew will be instructed to assist in observing any marine mammals while they are on watch.

The *R/V* Langseth will serve as the observation platform for marine mammals during the proposed 2014 survey. When the PSVO is stationed on the observation platform, the PSVO eye level will be approximately 21.5 meters above sea level, and each observer will have a good view around the entire vessel. PSVOs will use reticle binoculars (7x50 Fujinon), big-eye binoculars (25x150), and the naked eye during observations. Laser range-finding binoculars (Leica LRF 1200 laser rangefinder or equivalent) will be available to assist with distance estimation. Those are useful in training PSVOs to estimate distances visually, but are generally not useful in measuring distances to animals directly; that is done primarily with the reticles in the binoculars. In addition, both forward-looking infrared camera and night vision monoculars will be available for use in low-light conditions.

Passive Acoustic Monitoring

Passive acoustic monitoring (PAM) will be conducted to complement the visual monitoring program. Visual monitoring typically is not effective during periods of poor visibility or at night, and even with good visibility, is unable to detect marine mammals when they are below the surface or beyond visual range. Acoustical monitoring can be used in addition to visual monitoring to improve species detection, identification, and localization of cetaceans. However, it should be noted that PAM only works when a marine mammal is actually vocalizing. During the proposed 2014 survey, PAM will be monitored in real-time so that visual observers can be advised when cetaceans are acoustically detected.

The PAM system available on-board the *R/V Langseth* consists of both hardware and software. The deployed part of the system includes a towed hydrophone array stretching approximately 250 meters behind the vessel. The hydrophones are located on the last 10 meters of the towed cable. The cable will typically be towed at 20 meters depth or less. The Pamguard software is used to amplify, digitize, and processed the acoustic signals received by the hydrophones. This particular system can detect marine mammal vocalizations at frequencies up to 250 kHz. The PAM hydrophones respond in the 10 Hz to 200 kHz bandwidth.

One Protected Species Acoustic Observer (PSAO) or one PSVO will monitor the PAM system at all times in shifts no greater than six hours. A PSAO will design and set up the PAM system and be present to operate, oversee, and troubleshoot any technical problems with the PAM system during the proposed survey. When the PAM system detects a vocalization, the PAM operator will alert the PSVOs to the presence of a marine mammal, and a power-down or shutdown can be initiated, if required. The PSAO will enter the vocalization data into a database. The data to be entered includes an acoustic encounter identification number, whether it was linked with a visual sighting, date, time when first and last heard and when any additional information was recorded, position, and water depth when first detected, bearing if determinable, species or species group (e.g., unidentified dolphin, sperm whale), types and nature of the sounds heard (e.g., clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.), and any other notable information.

PSVO Data and Documentation

PSVOs will record data to estimate the numbers of marine mammals exposed to various received sound levels and to document the behavior of the animal upon sighting. These data will be included in the report submitted to the NMFS and will be used to estimate numbers of marine mammals potentially "taken" by harassment. PSVOs will also provide information needed to order a power-down or a shutdown of airguns when marine mammals are within or near the appropriate EZ.

When a sighting is made, the following information about the sighting will be recorded:

1. Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from seismic vessel, sighting cue, apparent reaction to the airguns or vessel (e.g., none, avoidance, approach, paralleling, etc.), and behavioral pace.
2. Time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare.

The data listed under (2) will be recorded at the start and at the end of each observation watch, and during watch whenever there is a change in one or more of the variables.

All observations and power-downs or shutdowns will be recorded in a standardized format. Data will be entered into an electronic database. The accuracy of the data entry will be verified by computerized data validity checks as the data are entered and by subsequent manual checking of the database. These procedures will allow initial summaries of data to be prepared during and shortly after the field program and will facilitate transfer of the data to statistical, graphical, and other programs for further processing and archiving.

Results from the vessel-based observations will provide:

1. The basis for real-time mitigation (airgun power-down or shutdown).
2. Information needed to estimate the number of marine mammals potentially taken by harassment, which must be reported to the NMFS.
3. Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted.
4. Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity.

5. Data on the behavior and movement patterns of marine mammals and turtles seen at times with and without seismic activity.

A report will be submitted to the NMFS and the USGS within 90 days of the completion of the proposed 2014 survey cruise. A second report will similarly be filed upon completion of the 2015 survey. The report will describe the seismic operations conducted and sightings of marine mammals within the vicinity of the operations. The report will include full documentation of methods, results, and interpretation pertaining to all monitoring. The report will summarize the dates and locations of seismic operations, and all marine mammal sightings (dates, times, locations, activities, associated seismic survey activities). Finally, the report will include estimates of the number and nature of exposures that could result in "takes" of marine mammals by Level B harassment or in other ways.

XIV. COORDINATING RESEARCH TO REDUCE AND EVALUATE INCIDENTAL TAKE

Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

The USGS will coordinate the planned marine mammal monitoring program associated with the seismic survey (as summarized in Sections XI and XIII) with any parties who express interest in this survey activity. The USGS will coordinate with applicable U.S. agencies (i.e., NMFS) and will comply with their requirements.

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